

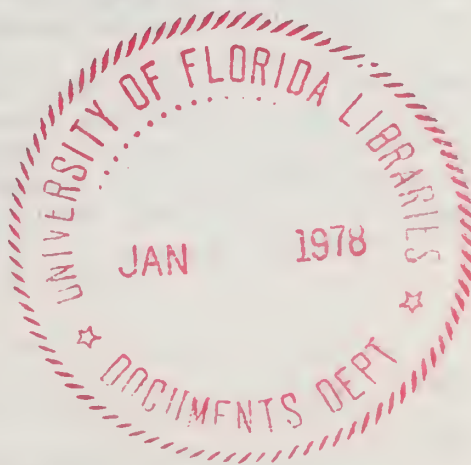
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94th Congress }
2d Session }

COMMITTEE PRINT

H.R. 12112
LOAN GUARANTEES FOR THE
PRODUCTION OF SYNTHETIC FUELS

COMPILATION OF STATEMENTS
OF WITNESSES BEFORE
THE SUBCOMMITTEE ON ENERGY AND POWER
MAY-JUNE 1976

COMPILED BY THE STAFF FOR THE USE OF THE
SUBCOMMITTEE ON ENERGY AND POWER
OF THE
COMMITTEE ON INTERSTATE AND
FOREIGN COMMERCE
U.S. HOUSE OF REPRESENTATIVES



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CONTENTS

Opening Statement of Hon. John D. Dingell, chairman, Subcommittee on Energy and Power-----	Page 1
--	-----------

WITNESSES

May 25, 1976:

Robert W. Fri, Deputy Administrator, Energy Research and Development Administration, Washington, D.C. (accompanied by Dr. William McCormick, Director, Office of Commercialization)-----	3
John A. Hill, Deputy Administrator, Federal Energy Administration, Washington, D.C.-----	15
Charles A. Berg, Buckfield, Maine (no statement)-----	
Monte Canfield, Jr., U.S. General Accounting Office, Director, Energy and Minerals Division, Washington, D.C.-----	21
Dr. Edward G. Cazalet, manager, decision analysis—energy, Stanford Research Institute, Menlo Park, Calif-----	30

May 26, 1976:

Dr. Barry Bosworth, research associate, Brookings Institute, Washington, D.C.-----	40
Laird Willott, senior vice president, Dillon, Read & Co., Inc., New York, N.Y.-----	49
Charles J. Cicchetti, director, office of emergency energy assistance, State of Wisconsin, Madison, Wis-----	87
Arthur S. Seder, Jr., president, American Natural Resources Co., Detroit, Mich-----	88
J. E. Bixby, vice president and chief financial officer, Texas Eastern Transmission Corp., Houston, Tex-----	99
Robert McClements, Jr., president, Sunoco Energy Development Co., Dallas, Tex-----	109
Hollis Dole, Washington representative, Atlantic Richfield Co., Washington, D.C.-----	117
Edmund M. Wheeler, president, The Fertilizer Institute-----	127

May 27, 1976:

Hon. Olin Teague, chairman, Committee on Science and Technology---	140
Don S. Smith, Commissioner, Federal Power Commission, (accompanied by: Leon Wahrhaftig, manager, Systems Operation Division, Bureau of Natural Gas; Dr. William Lindsey, Assistant Chief, Office of Economics; Jane Drennan, attorney, Office of Special Assistance; and Dan Goldstein, attorney, Federal Power Commission)-----	147
George Percival, director, British Gas Corp., International Gas Consultancy, Ltd., Stamford, Conn. (no statement)-----	
Fletcher L. Byrom, chairman of the board, Koppers Co., Inc., Pittsburgh, Pa-----	235
Kathy C. Shreve, acting project director, solid waste ammonia project, office of management and budget, city of Seattle, Wash. (no statement)-----	
Marilyn Romans, director of corporate planning, Fusion Energy Corp., Princeton, N.J-----	240
Thomas B. Neville, director, Stanford Western Energy Policy Study, Stanford, Calif-----	245
Milton Beychok, consulting engineer, 17709 Oak Tree Lane, Irvine, Calif-----	254

IV

May 27, 1976 :—Continued

John L. McCormick, Washington representative, Environmental Policy Center, Washington, D.C-----	Page 268
Carolyn Ruth Johnson, chairman, mining workshop, Colorado Open Space Council, Denver, Colo-----	275
Garry DeLoss, staff attorney, Public Interest Research Group, Washington, D.C-----	287

June 8, 1976 :

Robert W. Fri, Deputy Administrator, Energy Research and Development Administration, Washington, D.C. (Accompanied by Dr. Philip C. White, Assistant Administrator for Fossil Fuel, ERDA ; Dr. William McCormick, Director of Office of Commercialization ; Dr. Raymond Zahradnik, Director of Office of Coal Conservation, Division of Coal Conservation ; Dr. Harry Johnson, Director of Planning Staff ; George Rial, Director of the Division of Demonstration Projects ; Len Topper ; and Lynn Rawicz, Deputy General Counsel) (no additional statement)-----

STATEMENTS SUBMITTED BY WITNESSES NOT APPEARING BEFORE THE SUBCOMMITTEE

Gov. Thomas P. Salmon, Governor of Vermont, and chairman of the Natural Resources and Environmental Management Committee of the National Governors' Conference-----	294
Gov. Richard D. Lamm, Governor of Colorado, and chairman of the synthetic fuels task force of the Natural Resources and Environmental Resources and Environmental Management Committee of the National Governors' Conference-----	305
Diane Yale Sauter, research director, emergency task force on energy options, Scientists' Institute for Public Information, New York, N.Y-----	314
James L. Liverman, Assistant Administrator for Environment and Safety, Energy Research, and Development Administration, Washington, D.C--	338

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CONGRESS OF THE UNITED STATES
HOUSE OF REPRESENTATIVES
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE
SUBCOMMITTEE ON ENERGY AND POWER
WASHINGTON, D.C. 20515

OPENING STATEMENT OF

THE HONORABLE JOHN D. DINGELL, CHAIRMAN

SUBCOMMITTEE ON ENERGY AND POWER

AT

HEARINGS ON SYNTHETIC FUELS COMMERCIALIZATION

MAY 25, 1976

This afternoon, the Subcommittee on Energy and Power is beginning three days of hearings on H.R. 12112, dealing with loan guarantees for the demonstration and commercialization of new energy technologies.

This bill, after being reported out of the Science and Technology Committee, was then sequentially referred to both this Committee and to the Committee on Banking, Currency and Housing. Under the terms of this referral, we must report back to the House on this legislation not later than June 10, 1976. I believe we have our work cut out for us.

As Chairman of the Energy and Power Subcommittee, I have spent a good part of these last two years examining this Nation's energy situation and, while I share in the general enthusiasm for broadening our energy resource base, I must admit that I have some questions concerning how we go about it. Utilizing the mechanism of Federal subsidy to engage these problems is of great interest to me particularly when, as indicated in testimony by Dr. Robert Seamans, the ERDA Administrator, this is only the beginning of a much larger program. I think it is of vital importance to make sure that we get off on the right foot and thus avoid perpetuating any first errors.

Secondary and tertiary recovery of oil and gas, solar and geothermal energy technologies and intensified conservation efforts have much to offer to this Nation's energy resource pool. Do we know how sound our present system of priorities for each of these activities is? How then should we

evaluate the effectiveness of the huge sums we are talking about in H.R. 12112?

I should like to note at this time, some of the questions brought up in the "Dissenting Views" of the Science and Technology Committee Report on this bill. My Colleagues, Messrs. Ottinger, Hechler, Blouin and Hayes have expressed some concern as to the shape this loan guarantee program has taken. In their dissenting views they have called this program uneconomic and declared that it would distort energy priorities in favor of high capital, high risk options to the detriment of conservation and renewable resources. They also expressed concern that this is merely another camel's nose under the tent with regard to the Rockefeller \$100 billion Energy Independence Authority, particularly since the House voted down a similar program offered as Section 103 of H.R. 3474 last year. These are all important questions which, I trust, will receive consideration during our present set of hearings.

I should like to offer one thought before we begin hearing testimony. This country and its economy were in a large part founded on the idea of risk and reward. In the special case of the synfuels loan guarantee program, we ought to keep in mind that the public is one of the parties at risk and that a successful venture ought to attempt to benefit the taxpayer as well as the large companies which have recently registered record profits and whose loans would, in this case, be guaranteed by the taxpayer.

With that thought, let us begin the task at hand. This afternoon we have both public and Administration witnesses. Gentlemen, let me welcome you all.

STATEMENT OF
MR. ROBERT W. FRI
DEPUTY ADMINISTRATOR
U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
BEFORE THE
SUBCOMMITTEE ON ENERGY AND POWER OF THE
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE
U.S. HOUSE OF REPRESENTATIVES

May 25, 1976

Mr. Chairman and Members of the Committee:

I am pleased to appear before you today as this Committee begins its consideration of H.R. 12112 which would provide to ERDA loan guarantee authority and authorization for synthetic fuel and other full-scale energy demonstration projects.

Mr. Chairman, the President strongly supports the early enactment of this legislation and believes it essential that the Congress move promptly and decisively on this proposal. In this regard, we at ERDA stand ready to assist you in whichever ways you desire in order that the Committee may rapidly become familiar with the important proposals contained in this legislation.

I would like to note at the outset, that there have been few energy legislative proposals which have been studied so thoroughly and received such detailed scrutiny. Last year, following the President's proposal for a synthetic

fuels program, a 50-man, 13-Agency Federal Task Force under the aegis of the Energy Resources Council completed a 2,200 page comprehensive study which resulted in a recommendation to the President for a 350,000 bbl/d commercial demonstration program. Last year, and again this year the House Science and Technology Committee completed 16 days of hearings on the loan guarantee and other aspects of this proposal and received testimony from more than 70 leaders representing Federal and state government, the financial community, industry, universities, environmental groups, Indians, labor, and consumers. The Science and Technology Committee and its staff have worked over the past two months to fashion, what I believe, is one of the most innovative, thoughtful and potentially effective pieces of new energy legislation. I would like to emphasize that this new loan guaranty legislation is different in several important respects from last year's bill and contains a number of significant improvements which are summarized in Attachment 1. As this Committee begins its consideration of H.R. 12112, I am hopeful that you also will become convinced of the soundness of this legislation and the important contribution it can make to addressing our Nation's serious energy problems.

Mr. Chairman, we believe sufficient studies have clearly shown the need for this program and it is now time for positive and decisive action on this proposal so that

we can begin laying the foundation for reducing our Nation's reliance on conventional supplies of oil and gas. Today, we are importing 40 percent of our petroleum supplies compared with 36 percent two years ago shortly before the Arab oil embargo. Our domestic gas production has been steadily declining for the past three years. I submit that it does not require a sophisticated understanding of energy matters to see the clear trend of increased reliance on imports, and I for one believe this Country must reverse it.

As you know, the President has proposed a comprehensive set of near-term energy supply and conservation measures that include Alaska and OCS development, use of our Naval Petroleum Reserves, auto fuel economy standards, appliance efficiency labeling, strategic oil storage, natural gas deregulation and others. But even if all of these measures were adopted immediately, U.S. domestic production of oil and gas is projected to resume again its decline in the late 1980s. This means that just to maintain oil imports at the current level of about 6 million barrels per day, synthetic fuels will have to be produced in substantial quantities early in the 1990s. In fact, ERDA projects that the demand for synthetic fuels will rise to 5 million barrels per day in 1995 and 10 million barrels per day in the year 2000 even assuming increased supplies resulting from gas deregulation and other supply measures and decreased demand from conservation. In order to achieve this production capacity, our

synthetic fuel industry would have to grow from 1 million barrels per day in 1985 at a compounded annual rate of about 17 percent per year -- a very optimistic target for such a capital intensive industry. Because of the long lead-times in constructing these plants and the regulatory uncertainties involved, we must begin now to establish the information and the experience necessary for growth of this industry in the late 1980s and early 1990s.

We cannot, however, expect the private sector to meet this need in a timely fashion without positive Government assistance. There are a number of serious obstacles now inhibiting private investment in this new and complex field. Uncertainties in both the future OPEC determined price of world oil, and in the price of synthetic fuels produced from the first few plants, are important factors discouraging private investment. If world oil prices were to fall substantially, large plant investments could not be paid off from the revenues generated from synthetically-produced fuels. Adding to this risk are other uncertainties including those related to environmental impacts, socio-economic impacts, financing of synthetic fuels facilities, availability of skilled labor and critical materials and public acceptance. These uncertainties must be identified and resolved in the near future if this Nation is going to achieve levels of private investment needed to finance the

production of several million barrels per day of synthetic fuels early in the 1990s.

Mr. Chairman, this is the reason the proposed legislation is needed now -- to enable the Federal Government to offer needed incentives to build and operate over the next five years a limited number of large scale plants to produce clean synthetic fuels from coal, oil shale and other domestic resources. Such a program (a possible project mix is illustrated in Attachment 2) will provide vital information concerning the commercial viability and environmental acceptability of each of the major synthetic fuels types in contributing to our Nation's future energy supplies.

Without such a program of Federal assistance we, as a Nation, run the risk of either seriously delaying the time when synthetic fuels can be available in the U.S. and thus substantially increasing our level of imports, or of inviting a crash synthetic fuels program five to ten years from now. The latter would entail a precipitous effort that undoubtedly would result in inadequate consideration of environmental, socio-economic and other local impacts that should be carefully provided for early in the commercialization process.

Mr. Chairman, I do not think we want to run the risk of repeating the experience we have recently been through in the nuclear power area, where many of the environmental, regulatory and other governmental policy uncertainties, not

having been fully resolved prior to wide commercialization, are now slowing the growth of this important energy source. We should learn from this experience and, in the synthetic fuels area, address and resolve any potential problems at the outset.

I would now like to make several general comments on the proposed legislation, H.R. 12112. It should be clearly understood that, in the case of the loan guaranties, the actual cost of this program to the government is expected to be only a fraction of the required loan guaranty authorization. We estimate, at a maximum, the budget authority needed to cover the \$4 billion in loan guaranties for the projects authorized by H.R. 12112 would be about \$1.0 billion or \$500 million each for FY 1977 and 1978. Because we do not expect any major plant defaults, we do not even expect that this amount will be needed, but it is required in order to make the guaranties credible to potential lenders. Attachment 3 provides estimates of credit authority, budget authority and budget outlays for the proposed program.

H.R. 12112, along with ERDA's existing authorities and other applicable laws, also includes the necessary safeguards to ensure that this program is carried out with minimum environmental and socio-economic impacts and with maximum overall benefit to the Nation. Examples of such key provisions are:

- A comprehensive \$300 million program for assisting local communities to finance essential public facilities needed as a result of the siting of a synthetic fuels plant.
- Environmental monitoring of each plant along with full compliance with the National Environmental Policy Act including site-specific Environmental Impact Statements.
- Review and approval, by the Governor of the potentially affected State, of each proposed demonstration project.
- Compliance with all applicable Federal and state environmental laws and regulations.
- Preparation of an assessment of water availability and the impact on water supplies of each proposed project.
- Review by the Attorney General and the Chairman of the Federal Trade Commission of all proposed guarantees to ensure no adverse impacts on competition or concentration in the energy industry.
- Encouragement of maximum participation in the program by small business.

- A statutory advisory panel to provide input into the program by affected states, Indian tribes, industry, environmental organizations and the general public.
- Acquisition of title by the government to inventions conceived in the course of demonstration projects with provisions for waiver in the cases it is desirable.
- Dissemination of information generated from the program to all interested parties, except for proprietary information and trade secrets.

In summary, Mr. Chairman, the proposed legislation is essential, it is responsible and I urgently request the Congress to act quickly and favorably on it.

Finally, I would like to note for the Committee that about two months ago, for the first time in our Nation's history, we actually imported more oil than we produced during a given day. Inasmuch as it would take us at least five to six years to build the first plants to replace these natural fuels from coal or shale, it would seem the height of national imprudence not to provide legislative means to proceed with such construction as quickly as possible. Our energy fuel clock is ticking away steadily. It is running down on an irreversible course and it is not going to wait for political considerations or resolution of all market uncertainties.

Thank you, Mr. Chairman. I will be pleased to answer any question you or any other member of the Committee may have at this time. We have provided the members of the Committee a detailed program fact book which is included as Attachment 4 to my testimony.

KEY MODIFICATIONS BY
HOUSE SCIENCE AND TECHNOLOGY COMMITTEE
TO SYNTHETIC FUELS PROGRAM

- Reduced original \$6 billion guaranty limit to \$4 billion for synthetic fuels, renewable resource and energy conservation projects.
- Provides that up to 50% (but no less than 20%) be used to demonstrate renewable energy resources and energy conservation technologies.
- Limits oil shale projects to "commercial modules" rather than full-scale commercial plants and authorizes "cost-sharing" agreements.
- Encourages maximum participation in program by small business.
- Stipulates that all demonstration projects be located within the United States.
- Establishes stringent conflict of interest requirements for ERDA officials administering program including public disclosure.
- Mandates ERDA Annual Reports to Congress on all major aspects of the program including any significant potential adverse impacts which may result and all funds received and disbursed under program.
- Requires that all proposed projects costing over \$200 million be subject to Congressional review and possible veto.
- Establishes a statutory advisory panel to ensure adequate consideration of views of affected States, Indian tribes, industry, environmental organizations, and the general public on the impact of the program.
- Requires competitive bidding procedures for ERDA awards.

Attachment 2

POSSIBLE \$4 BILLION PROGRAM

<u>Fuel Category</u>	<u>Plant Type</u>	<u>No. of Plants</u>	<u>Guaranty Amt. Needed</u>	<u>% By Category</u>
<u>High Btu Gas</u>	High Btu Gas	2	1,600 million 1,600 million	<u>40%</u>
<u>Other Fossil</u>	Shale Conversion (single module)	2	1,200 million 400 million	<u>30%</u>
	Utility and Industrial Fuels (low, medium Btu gas, methanol, SRC)	4	800 million	
<u>Biomass, Renew- ables, Conser- vation, etc.</u>			800 million	<u>20%</u>
	Biomass (municipal, wood, agricultural, industrial waste)	6	300 million	
	Renewables (direct waste utilization, solar, etc.)	5-10	300 million	
	Industrial Conser- vation	5-10	200 million	
<u>Impact Assistance</u>			300 million	<u>7%</u>
<u>Contingency</u>			100 million	<u>3%</u>
	TOTAL		4,000 million	

Synthetic Fuels Commercial Demonstration Program Budget

Exhibit 4: Five year Budget Projections for 200,000 bbl/day Program

	FY 1976 & TQ	FY 1977	FY 1978	FY 1979	FY 1980	FY 1981	FY 1982
<u>Net Budget Outlays</u>							
Administration	2	12	14	1	(5)	(11)	(17)
Loan Guarantee	1	13	18	15	15	15	15
Price Guarantee	0	0	0	0	0	0	0
Construction Grants or Cost Sharing	0	0	0	0	0	0	0
Planning Grants	1	2	2	0	0	0	0
Loan Guarantee Fees Collected	(0)	(3)	(6)	(14)	(20)	(26)	(32)
<u>New Budget Authority</u>	<u>4</u>	<u>518</u>	<u>515</u>	<u>15</u>	<u>15</u>	<u>15</u>	<u>15</u>
Loan Guarantees	0	500	500	0	0	0	0
Price Guarantees	0	0	0	0	0	0	0
Construction Grants or Cost Sharing	0	0	0	0	0	0	0
Planning Grants	2	3	0	0	0	0	0
Administration	2	15	15	15	15	15	15
<u>New Credit Authority</u>	<u>0</u>	<u>2,000</u>	<u>2,000</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Loan Guarantees	0	2,000	2,000	0	0	0	0
Price Guarantees	0	0	0	0	0	0	0

1/ Funding for FY 1977 and beyond are shown for illustrative purposes as if these programs were funded in EPPA. If, however, EIA is created in FY 1977, the Synthetic Fuels Program would be transferred to it.

2/ No payments for either loan guarantee defaults or price supports are anticipated during this period.

3/ Specific authorization and appropriation will be requested on a case by case basis under the Non-Nuclear Act if determined to be required.

4/ Specific authorization and appropriation will be requested at a future date under the Non-Nuclear Act if determined to be required.

STATEMENT OF JOHN A. HILL
DEPUTY ADMINISTRATOR
ENERGY RESOURCE DEVELOPMENT
FEDERAL ENERGY ADMINISTRATION

Before the
ENERGY AND POWER
SUBCOMMITTEE
of the
HOUSE INTERSTATE AND FOREIGN COMMERCE COMMITTEE
May 25, 1976

Introduction

Mr. Chairman and Members of the Committee, I am pleased to testify today in favor of H.R. 12112 which would amend the Federal Nonnuclear Energy Research and Development Act of 1974.

H.R. 12112 would provide Federal assistance for a demonstration program to produce synthetic fuels from coal, oil shale, and to convert renewable energy resources to desirable energy forms.

I cannot emphasize too strongly, Mr. Chairman, that there is an urgent national need to increase the production of energy supplies from our abundant domestic resources. H.R. 12112, as reported out by your colleagues in the House Science and Technology Committee, represents an important milestone toward meeting that need.

Our Nation has been blessed with an abundance of energy resources. Our emergence as a world power reflects that fact. We still have an abundance of energy resources, but the domestic resources we rely on most--oil and gas--are dwindling rapidly. Meanwhile, the use of our more plentiful resources is limited by the lack of adequately proven technology, unfavorable economics, and concern over environmental consequences. The result has been a growing dependence on imported energy, the availability and price of which is controlled by a few countries.

Let us explore the energy picture a little further:

- Oil production in this country is more than a million barrels a day less than at the start of the embargo.
- The natural gas problem continues to worsen. Proved reserves in the lower 48 states have declined steadily. Production is also declining at the rate of 6 to 7 percent a year.
- Of our fossil fuels, only coal production increased last year. And it was only six percent higher than the year before.
- Finally, more than one-half of all new coal and nuclear power plants scheduled for operation between now and 1985 have been deferred or delayed in the last 18 months.

As you can see Mr. Chairman, the short-term energy situation is not bright. Moreover, our long-term energy situation will be worse unless we take positive actions to increase supply and reduce demand. If we do nothing, oil imports will reach dangerously high levels between now and 1985.

H.R. 12112 is an important piece of legislation. Its enactment will be a key step to accelerating the development of alternative domestic energy supplies. These supplies will be vitally needed as our traditional energy supplies--notably oil and gas--continue to decline. Thus, H.R. 12112 may be viewed as a long-term energy insurance policy--a policy we cannot afford to be without.

The long-term nature of alternative fuels technology must be emphasized to underscore the need to get started now. Consider, for example, that the first nuclear powerplant was built in the mid-fifties. Yet it wasn't until 1970 that we obtained as much energy from nuclear power as we obtain from firewood.

The lead-time problem will also apply to synthetic fuels, solar energy and geothermal energy. To overcome this problem, we will have to provide Federal assistance during the next decade to bring these new technologies to commercial use. H.R. 12112 authorizes a demonstration program; thus, the quantity of synthetic and other fuels produced will not be large. However,

enactment of this legislation will help remove the barriers and lay the groundwork for the accelerated development of one or more major energy industries in this country before the turn of the century.

Synthetic fuels will not be inexpensive. Between now and 1985, we estimate they will be more costly than both domestically-produced and imported petroleum. But if we don't invest the financial resources now, in the years beyond 1985 when our oil and natural gas reserves are further depleted, we won't have a chance to replace them in a timely manner.

Thus, Federal participation in a synthetic fuels program should be viewed as a deposit in an energy savings account that will be returned to the Nation with substantial interest. The same thing may be said for efforts that are underway to develop other new energy technologies.

I would like to comment on a few provisions of H.R. 12112 which are exceptionally noteworthy.

First, it is widely recognized that commercial size synthetic fuel plants and related facilities have the potential to create significant environmental damage if not designed and operated properly. One of the stated objectives of this legislation is to gather information about the environmental consequences of such facilities. This objective will ensure that reliable environmental data is obtained, with the plants using advanced control techniques, to provide a sound basis

upon which to regulate air quality, water quality, and land disturbance of a future synthetic fuels industry.

Secondly, synthetic fuel plants can have significant impacts on state and local communities. Some of the effects would be beneficial, such as new job opportunities. In some areas, a synfuel plant would result in rapid population growth. With lack of planning, rapid growth is accompanied by such adverse impacts as disruption of local labor markets, severe housing shortages and lack of essential community services. The proposed legislation requires the Federal Government to inform appropriate state and local officials as soon as the location of a proposed facility is determined and provides for planning assistance.

But more importantly, H.R. 12112 would establish a panel to advise the ERDA Administrator on the impacts of the program on communities, states, and Indian tribes, and on environmental and health and safety effects of synfuel plants. One of the panel members shall be designated by the National Governors Conference. Other members will come from Indian tribes, environmental organizations and the general public. This panel will help ensure that the Federal Government is responsive to the needs and concerns of state and local governments.

Finally, Mr. Chairman, I would like to point out that this Nation still faces an energy crisis. The most serious causes

of this crisis are the uncertainty as to future supplies and prices, uncertainty as to Federal regulatory policies, and uncertainty as to future markets.

I'm firmly convinced that passage of H.R. 12112 in essentially its present form would remove a substantial part of this uncertainty and help resolve our future energy supply-demand imbalance. The benefits would be two-fold: first, between now and 1985, we would gain valuable data and experience in producing synthetic and other fuels on a commercial scale. Second, passage of this legislation would demonstrate that we, as a Nation, have the resolve to undertake a difficult task. This alone would help remove some of the uncertainty associated with our energy policy.

I urgently request that your Committee and the Congress act expeditiously and favorably on this important piece of legislation.

Thank you. I will be glad to answer questions you may have.

United States General Accounting Office
Washington, D.C. 20548

FOR RELEASE ON DELIVERY
EXPECTED TUESDAY AFTERNOON
May 25, 1976

Statement of
Monte Canfield, Jr.
Director, Division of Energy and Minerals
before the
Subcommittee on Energy and Power
Committee on Interstate and Foreign Commerce
United States House of Representatives
on
Developing and Commercializing Energy Technology

Mr. Chairman and Members of the Committee, we welcome the opportunity to be here today to consider with you the difficult problems of developing and commercializing energy technology. I would like to lay out a perspective and then focus my comments on two things:

- an overview of the scope of various legislative proposals now before the Congress that would provide various combinations of Federal financial support for developing and commercializing energy technologies;
- a brief description of recent and ongoing GAO work bearing on the question of Federal financial assistance for developing and commercializing energy technologies.

PERSPECTIVE ON ENERGY DEVELOPMENT

A large number of issues and choices face Congress in dealing with energy development. Energy development is a slow process. Legislative action will occur years in advance of actual impacts. While we recognize

that legislative decisions will be required without full information, it is important that the Congress and the Nation focus on some critical issues and trade-offs that can enhance the quality of the decisions to be made.

First, there are no simple choices. Each technology has to be weighed against the benefits and costs of competing options. Those options are not only on the domestic production side. For example, while often overlooked, conservation is truly one of our least costly supply options. Consideration of financing conservation improvements as alternatives to, and complements to, large capital-intensive supply technologies is essential to rational decisionmaking.

Second, although no consensus exists among financial experts, sufficient capital will probably not be forthcoming to support the entire range of developing energy technologies. We can't do everything--we must choose. Further, since it is unlikely that private industry will be able to capture the benefits of many of the more expensive and risky research and development options, some form of Government financing will probably be necessary to stimulate new energy technologies. Developing the criteria to choose among competing technologies and choosing the funding levels for each will be difficult, but equally essential.

For each option we should pursue the question: When could the technology be commercialized? Also the energetics, or thermodynamic efficiencies, should be carefully weighed. Such a weighing of the

net energy output for each technology, will enable us to make energy efficiency comparisons among competing technologies. Adverse environmental effects and social costs of development must be considered as part of the total cost of any energy development project. Also, external influences, such as dependence on foreign oil, must be considered in choosing among future options and short term security.

Even once a decision is made to pursue a given option, we are not home free. Deciding among the most desirable methods for encouraging development, including various forms of Government ownership, tax policy, import controls, loan guarantees, price supports, etc., all depend upon the technology and the energy strategy and goals.

ENERGY DEVELOPMENT LEGISLATION

With this perspective in mind, it is useful to recognize that there are three main types of legislative proposals to financially assist the development of new energy technologies. Only by looking at all three areas comprehensively can a true picture of the total costs of energy development emerge.

First, what is termed "front-end" assistance is proposed. This amounts to subsidies to states and local governments in regions which are largely rural and unindustrialized to help them plan for development and to provide the public facilities necessary as a result of the development. Assistance could be in the form of loans, loan guarantees, and planning grants.

Second, since private investors are reluctant to build and operate new risky commercial or near-commercial facilities, incentives in the form of loan guarantees, interest subsidies and tax write-offs are proposed.

Finally, even after commercial-sized plants are subsidized and operating, there is a potential that synthetic fuels will be too high priced to compete with alternatives such as domestic oil and coal or oil imports. Therefore, subsidies to producers in the form of price supports or to users in the form of tax incentives or low interest loans have been proposed to enable higher cost technologies to compete in the market place.

For example, legislative proposals have been submitted which would guarantee purchase of products. One would set up a board to purchase synthetic fuels and solar energy, and auction them off to the highest bidder. Some of these proposals cover more than one of the three financing categories discussed; but none is truly comprehensive. The point is that no one piece of proposed legislation covers in any comprehensive way the entire range of financial support being considered.

ENERGY INDEPENDENCE AUTHORITY

The Administration's most comprehensive energy development proposal would establish an Energy Independence Authority (EIA). The bill, S. 2532, would encourage the development and commercial operation of domestic energy sources and to a lesser extent, encourage energy conservation. A total of \$100 billion would be available to the EIA. The proposal would

authorize direct investment in energy technologies, loans, loan guarantees, and price guarantees.

Our central concern lies in the proposal's lack of balance. The bill exhibits a clear preference for initiatives of the supply-increasing variety. According to one provision of the bill the conservation projects eligible for funding appear to be those not in widespread use. This would appear to preclude, for example, assistance to a utility-administered residential insulation project, since home insulation is already in "widespread domestic commercial use". No equivalent condition is attached to supply increasing projects.

The bill would hamper conservation efforts rather than simply fail to promote them. This is true because the bill would result primarily in the allocation, not creation of capital. The EIA's loan funds would, in large part, be raised in the private capital market. Its guarantees would make projects it assists financially more attractive to private capital than conservation projects not backed by Federal guarantees. Thus, both its loans and its guarantees will siphon private capital away from conservation projects which might have been able to obtain private financing in the absence of EIA operations.

The choice of projects to receive financial assistance, and the form of assistance, ought to be based upon reasonable forecasts of the degree to which each project will advance the goal of independence per

dollar of assistance accorded it. We believe that many initiatives in the direction of conservation hold the promise of moving the country farther down the road toward energy independence per dollar spent than do most supply increasing options.

In addition, the bill is underlaid by some assumptions regarding national policy which are by no means settled. Its predilection toward nuclear power generation is the most obvious example. Another is seen in its willingness to give the Government a large quasi-commercial interest in energy supplies which would be in competition with imported crude oil. Since the bill does nothing to limit imports directly, the underlying assumption appears to be that world crude prices will stay high enough to insure the profitability of the EIA's investments in alternative domestic supplies. Thus, the Government would have a financial interest in keeping world crude prices artificially high. We believe that legislation regarding financial support for synthetic fuels and other energy development should be coordinated in a systematic framework which includes all the likely costs associated with development and detail on the mix, number, and size of plants, and types of financial support needed for each. Specifically, adequate financing for synthetic fuels commercialization requires further information, analysis, and evaluation of many factors, particularly the arrangements for subsidies or price supports which may be necessary to make synthetic fuels competitive. Subsidies or price supports in turn raise the question of Government energy pricing policy. For

example, oil and gas prices are being held down by regulations while it appears that it would be necessary to subsidize higher cost synthetic fuels. While legislation on energy development need not be comprehensive, it should seem obvious that a balanced and consistent energy strategy can provide a useful framework within which individual proposals can be evaluated.

SYNTHETIC FUELS REPORT

Our March 1976 report discussed an Administration proposal to authorize ERDA to provide up to \$6 billion in loan guarantees for, among other things, commercial demonstration facilities for the production of synthetic fuels. To encourage industry to participate in synthetic fuels commercial demonstration programs the Administration recommended Government incentives consisting of loan guarantees, price supports, and construction grants.

Because of time constraints we did not evaluate the pros and cons of the various forms of Federal assistance considered by the Administration in arriving at its recommendation in that report. We did note, however, that important policy and judgmental questions were involved in arriving at the recommendations. A different emphasis on certain considerations such as impact on the budget, degree to which an alternative preserves and enhances competition, ability to achieve program goals, and extent of Federal involvement in management of operations--could conceivably lead to a different choice of alternative forms of assistance.

We stated our view that the Congress should consider awaiting further studies which ERDA expects to complete in July 1976 before approving any legislation. The studies should provide better information on the scope

and magnitude of Federal assistance needed to carry out the programs, including better information on the type and number of plants needed.

ON-GOING GAO WORK

GAO has undertaken a review which focuses on technologies that have demonstrated technical feasibility but which do seem to have impediments to full commercialization. These impediments are caused by a variety of non-technical reasons such as financial, environmental, and regulatory. The technologies considered are synthetic fuels, solar and geothermal energy, enhanced oil and natural gas recovery and certain conservation measures. Within this framework we will first address future supply/demand balances to the year 2000 and consider the probable roles of each of these technologies. We will attempt to determine the current status of each of the technologies and the current impediments to commercialization as well as the pros and cons of various Government options to stimulate financing activity. The options will cover such mechanisms as direct loans, loan guarantees, price guarantees, tax incentives and Government ownership.

We will then attempt to evaluate what priorities the Government should attach to the various technological options for the purpose of allocating funds or guarantees. In this section we will consider various social and economic goals such as obtaining the most energy at least cost, the maintenance of a competitive environment, economies of scale, tradeoffs between first and second generation technologies and the implications of on-budget and off-budget financing. As a conclusion, we will attempt to specify

legislative or policy approaches would, in our judgment, allow the most consistent and systematic consideration of Government role in financing energy commercialization efforts. We will also identify key tradeoffs in this area between the supply and conservation options considered in our report.

As you can see, Mr. Chairman, there are matters requiring closer examination regarding the scope and magnitude of Federal financial support for synthetic fuel and other forms of energy development. We hope that our further study will provide some useful insights on these matters. We plan to complete our study in mid-summer which is around the same general timeframe that ERDA plans to complete its follow-up studies on synthetic fuels.

I want to emphasize that our study not only addresses the fundamental question of whether early commercialization of synthetic fuel technology should be pursued as aggressively as the Administration proposed but also the broader question of how this country can best provide for its future energy needs.

In summary, we are suggesting that information which should be available from ERDA and GAO this summer should be helpful to the Congress as it proceeds toward final legislative action on H.R. 12112 or any of the other bills currently in Congress dealing with the Federal financial support for construction costs, price supports, and initial costs to State and local governments.

Mr. Chairman, this concludes my prepared statement. We will be glad to respond to questions.

May 25, 1976

PREPARED STATEMENT BY DR. EDWARD G. CAZALET
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STANFORD RESEARCH INSTITUTE, MENLO PARK, CALIFORNIA

Mr. Chairman and members of the committee: I am pleased to be here today to discuss the synthetic fuels bill (HR 12112). My statement is based on my consulting work for the Synthetic Fuels Inter-agency Task Force and for other government agencies and private energy companies. In my work for the Synthetic Fuels Task Force I directed a team of SRI analysts who worked closely with government experts and analysts to conduct an overall cost/benefit analysis of synthetic fuels commercialization policy. In making this statement I do not represent the Synthetic Fuels Task Force, SRI, or any of the other organizations for which I have consulted. All of the information I will quote today is publically available and much of it is documented in Volume II of the report by the Synthetic Fuels Task Force Report.*

I think most of us agree that decisions concerning government incentives for synthetic fuels commercialization are very complicated. Necessarily, many of the factors affecting the desirability of government support for synthetic fuels are uncertain or involve difficult value judgments. For example, the future costs of imported oil and synthetic fuels are highly uncertain and have a major impact on the ultimate market for synthetic fuels. Also, value judgments on the indirect international relations effects of depending on fuels are

* "Recommendations for a Synthetic Fuels Commercialization Program: Volume II-Cost/Benefit Analysis" report submitted by the Synthetic Fuels Interagency Task Force to the President's Energy Resources Council, November 1975, for sale by the U.S. Government Printing Office, Washington, D.C., 20402, price \$4.20, stock number 041-001-00111-3.

clearly central to the decision on the synthetic fuels bill. In my statement I will focus on these and other important factors affecting this decision.

The most important economic factor affecting decisions on commercializing synthetic fuels is the size of the future market for synthetic fuels. Figures 1 and 2 show the total quantity of synthetic fuels that would be produced under different assumptions concerning synthetic fuels costs and imported oil prices. The vertical scale on the figures is expressed in quadrillions of Btu's per year on the left and millions of barrels per day of oil equivalent on the right. (For comparison, the total U.S. oil and gas consumption in 1975 was about 26 million barrels per day.) The horizontal scale spans the next fifty years.

The nominal or middle case shown in both figures projects synthetic fuels production at about 10 million barrels per day in the year 2000. Many assumptions underly the nominal case. For example, the nominal case assumes the imported oil price will increase continuously to about \$18 per barrel in 1975 dollars by the year 2000. The low import price case in Figure 1 assumes import prices drop to about \$8 per barrel and then rise to current levels by the year 2000. The assumption of low import prices reduces the projected synthetic fuel production considerably. The assumption of high import prices, \$3 per barrel higher than for the nominal case, increases synthetic fuels production only slightly. Clearly, the market potential for synthetic fuels is highly dependent on imported oil prices.

The cost of synthetic fuels is also an important determinate of the size of the synthetic fuels. The average cost of synthetic fuels in the nominal case is about \$15 per barrel at the plant. If the cost of synthetic fuels is high, \$22 per barrel, the production of synthetic fuels is reduced considerably. If the cost of synthetic fuels is only \$12 per barrel there is a slight increase in production over the nominal case.

Figures 1 and 2 illustrate the great uncertainty in the size of the future synthetic fuels market. Joint variations in synthetic and imported fuel costs would produce even wider variations in synthetic fuels production.

Other variables affect synthetic fuels production but not to the same degree as imported oil prices and synthetic fuels cost. Figures 3 and 4 show the effect of changes in assumptions regarding domestic oil and gas availability and end-use total energy demand. Uncertainty about these variables is less important than uncertainty about synthetic and imported fuel prices.

Some variables while important for other reasons, have no effect on synthetic fuels production. For example, a national nuclear moratorium would not significantly affect synthetic fuels production because the best alternative to nuclear for electric power production is coal.

The uncertainty in the market potential as illustrated by these figures is a major reason why commercial synthetic fuels projects have not proceeded. Presently this uncertainty is reflected in terms of the inability of private companies to raise capital for synthetic fuels projects. Thus many companies have concluded that the only way a synthetic fuels industry can develop at this time is with government loan guarantees and other incentives.

A decision on government guarantees and incentives for synthetic fuels must take account of a broad range of international, environmental and economic issues in addition to the market economics faced by private industry. Synthetic fuels are a substitute for imported fuels. Dependence on imported fuels involves such concerns as international relations, balance of payments and exposure to future embargoes. On the other hand, dependence on synthetic fuels involves environmental consequences and large capital investments. Also, early development of a synthetic fuels industry would reduce uncertainty about synthetic fuels technology and contribute to lower costs for later synthetic fuels plants through development of infrastructure and technological learning. Many of these important issues are not fully accounted for in corporate decision making and therefore must be accounted for in the government's decision.

The Synthetic Fuels Task Force with the assistance of SRI, performed a comprehensive analysis of four levels of synthetic fuels commercialization programs: no program; an information program of 350,000 barrels per day by 1985; a medium program of 1,000,000 barrels per day; and a maximum program of 1,700,000 barrels per day. The analysis considered several thousand possible outcomes under varying conditions of imported oil prices, synthetic fuel costs, domestic energy supply and demand and future corporate synthetic fuels investment. Judgments by the task force on crucial factors were made explicit in the analysis. The overall measures of net benefit produced by the analysis reflect all significant categories of cost and benefit with the exception of specific international relations categories that I will describe shortly.

As shown in Figure 5, the expected costs of all commercialization program levels exceed the benefits. Relative to no government program, the expected discounted net benefits (in 1975 dollars) are:

- o -1.6 billion for the information program
- o -5.4 billion for the medium program
- o -11.0 billion for the maximum program

It is important to note that there is considerable uncertainty in the ultimate net benefit. This uncertainty is explicitly accounted for in the analysis by weighting the net benefit of each possible outcome by the probability that it will occur. The analysis showed, for the information program, that there was a 10 per cent chance that the net benefit of this information program would exceed 7 billion dollars and correspondingly, a 10 per cent chance that the net loss would exceed 9 billion dollars. When the benefit levels are properly weighted by their corresponding probability the resulting expected net benefit is negative.

The key factor affecting the net benefit of a synthetic fuels commercialization program is the strength of the oil producers' cartel. A strong oil producers' cartel in 1985 was judged to increase prices of imported oil by 4 to 9 dollars per barrel over that of a weak cartel. The probability of a strong cartel existing in 1985 was assessed at 50

per cent by the task force. Figure 6 shows how the net benefit of the synthetic fuels program levels are affected by the probability assigned to a strong cartel in 1985. The vertical scale measures net benefit; the horizontal scale is the probability assigned to a strong cartel in 1985. If a weak cartel occurs all program levels have highly negative net benefits; if a strong cartel occurs all program levels have positive net benefits. Assuming all other factors are held constant, the breakeven probability required to justify a synthetic fuels program is 80 per cent.

Wide differences of opinion on the probability of a continuing strong cartel exist. Some argue that the free market always prevails and therefore they advocate assigning a very low probability of a strong cartel existing. Others assign a high probability of a strong cartel on the basis that unless we believe the cartel will remain strong we will not take the necessary actions to help weaken the cartel. Neither extreme is correct. Clearly the assessment of the strength of the cartel is a difficult judgment but it is one that must be made on the basis of the best available information in order to formulate a wise policy on synthetic fuels.

Three categories of overall benefit were defined by the analysis: economic benefit, dependence costs and environmental and socioeconomic costs. Economic benefit is the difference between what the country would pay for fuels without a synthetic fuels program and what it would pay with a synthetic fuels program. For example, the net economic benefit of the information level program is negative, a 1.7 billion dollar net loss because the expected synthetic fuels costs are higher than the expected imported fuels costs.

Dependence costs include future embargo losses, balance of payments costs and international relations costs. The analysis credited a synthetic fuels program with any reductions in dependence costs that would result from substituting synthetic fuels for imported fuels. Assuming the probability of another embargo to be 10 per cent per year, the information level synthetic fuels program is credited with 400 million dollars reduction in expected embargo loss. This reduction may appear small but the amount of synthetic fuels produced by the program is also

small relative to total imports and large reductions in imports as a result of synthetic fuels only occur under conditions where synthetic fuels are much cheaper than imports.

With respect to concern with embargoes, it is worth noting that a strategic storage program is a much more effective alternative for reducing embargo losses. On the same basis as the synthetic fuels analysis, a storage program of 600 million barrels has an expected positive net benefit of 9 billion dollars.

The effect of a synthetic fuels program on U.S. balance of payments was judged insignificant. Possible reductions in imports over the long life of a synthetic fuels plant would be balanced by reductions in U.S. exports of other goods. Thus, there would be no significant net impact on U.S. employment, tax revenues, or gross national product. In other words, the balance of payment effects on this synthetic fuels decision can be safely ignored.

International relations costs or benefits could include demonstration to other nations of U.S. resolve to be a world leader in energy or perhaps the economic benefits to other nations of a U.S. program. But the crucial international relations issue is whether U.S. foreign policy interests would be improved or degraded by reduced imports of fuel from other nations. The task force analysis was unable to draw any firm conclusions on this benefit category and the 1.6 billion dollar net negative benefit for the information level program does not assign any costs or benefits to the international relations effect. The implication is that those who assign a high positive benefit to the international relations effect (greater than the 1.6 billion dollar loss) should support a synthetic fuels commercialization program.

Another way to illustrate the importance of the international relations issue is to consider the effect of an import quota on the value of a synthetic fuels program. If the government should adopt a quota at about the current level of six million barrels per day of imports, the information level program would have strongly positive net benefits of about 5 billion dollars. On the same basis, however, the cost to the nation of the import restrictions would be 44 billion dollars.

The final category of benefits includes environmental and socioeconomic costs. The costs of complying with present and future environmental standards and providing for a portion of the community infrastructure are included in the costs of synthetic fuels. The high level of uncertainty about environmental and socioeconomic costs is one reason for the uncertainty in the cost of synthetic fuels.

The economic costs of synthetic fuels do not include the social costs of synthetic fuels associated with residual air emissions, water quality and depletion, land disturbance, health and safety, and social disruption impacts. The cost/benefit analysis utilized rough judgments on the equivalent dollar costs of these impacts. The total discounted external environmental cost of the information level program was about 400 million dollars. Coincidentally, this cost approximately balances the embargo costs associated with imported fuels.

Finally, I must emphasize that all projections of future energy supply and demand tell us that synthetic fuels will ultimately take their place in the market; only the timing of this event is uncertain. Moreover, the task force analysis says nothing about the benefits of continued research and development on synthetic fuels; presumably continued research and development including the construction of modules of potentially commercial plants is beneficial.

Government decisions on the commercialization of synthetic fuels involve the commitment of large amounts of national resources. Regardless of whether the government incentives take the form of loan guarantees, price supports, capital grants, tax relief, or regulatory changes, it is the consumer who pays the bill. Since government decisions are not subject to the normal economic checks and balances of the market place it is essential that decisions on synthetic fuels commercialization be based on the best available analysis and expert judgment and not on the emotions of the moment.

Figure 1

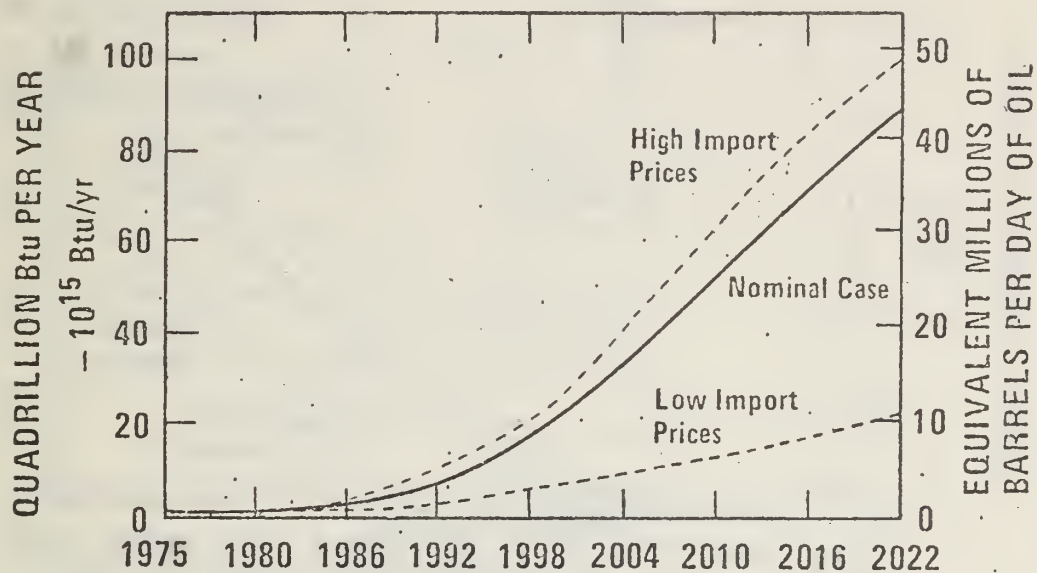
SYNTHETIC FUEL PRODUCTION SENSITIVITY
TO IMPORT PRICES

Figure 2

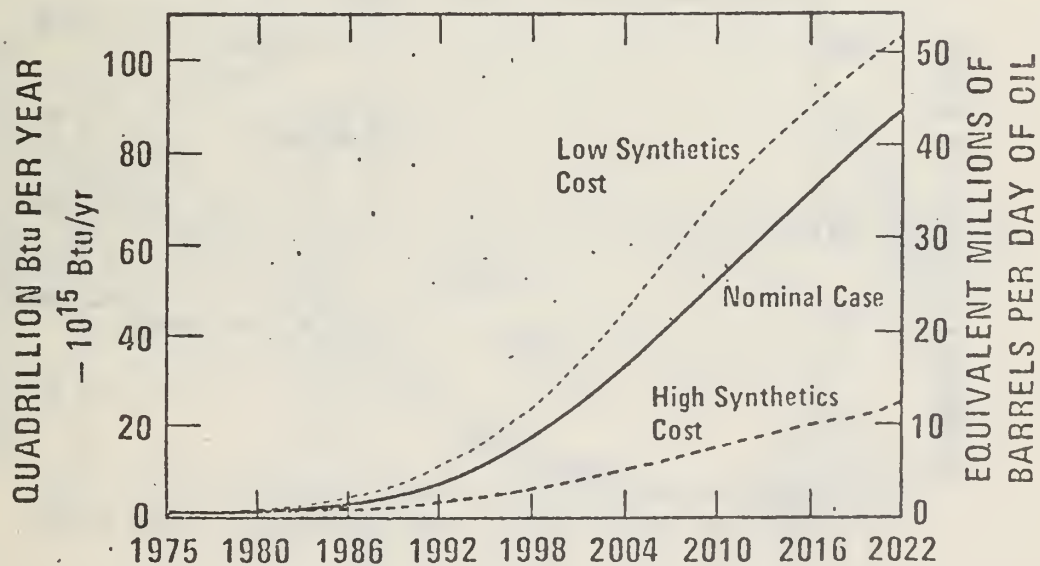
SYNTHETIC FUEL PRODUCTION SENSITIVITY
TO SYNTHETIC FUEL COST

Figure 3

SENSITIVITY OF SYNTHETIC FUEL
PRODUCTION TO U.S. GAS AND OIL
RESOURCE POSITION

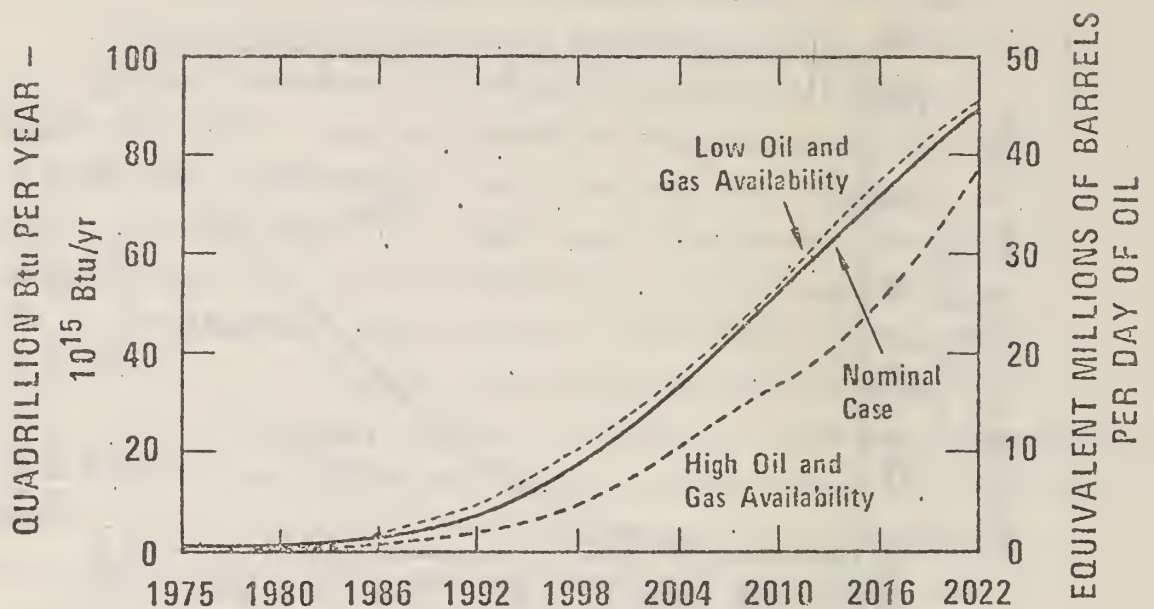


Figure 4

SYNTHETIC FUEL PRODUCTION SENSITIVITY
TO TOTAL DEMAND

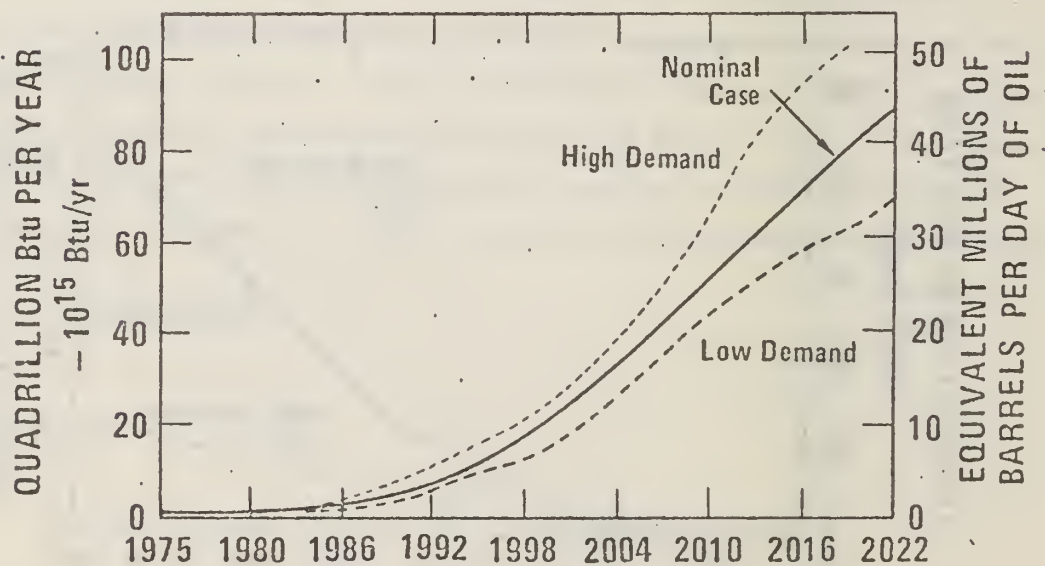
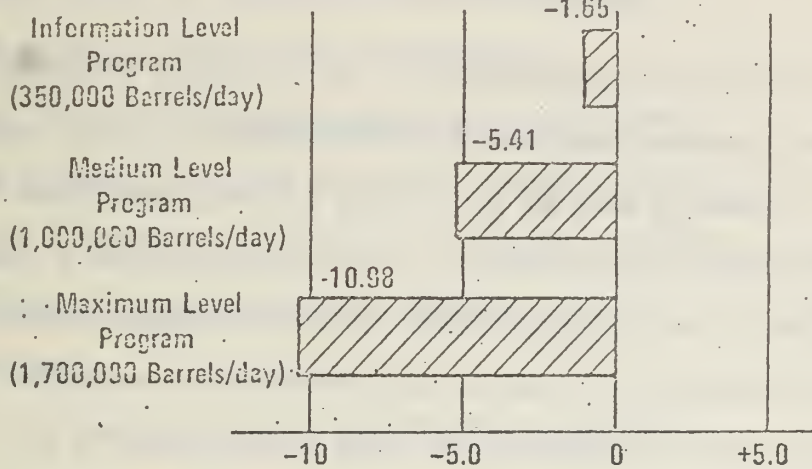


Figure 5

DECISION ANALYSIS OF THE SYNTHETIC FUELS COMMERCIALIZATION PROGRAM

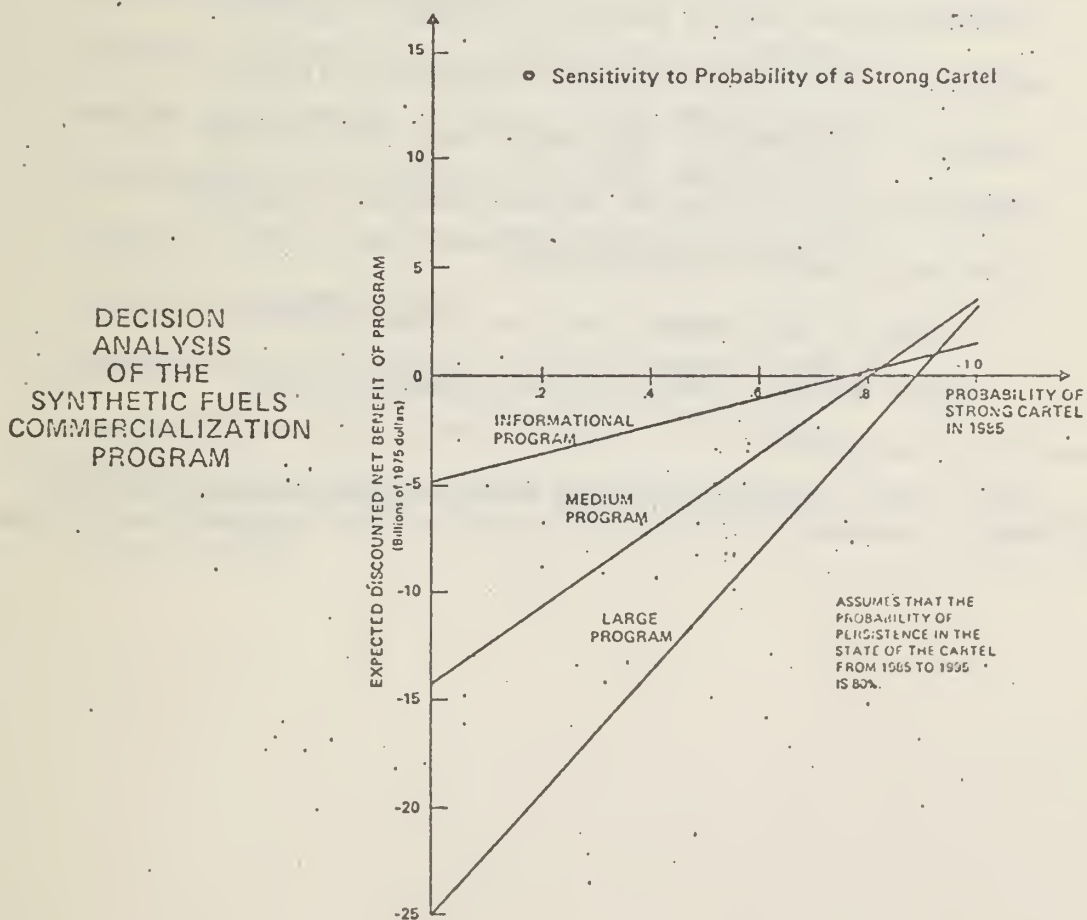
• Results of Analysis



EXPECTED DISCOUNTED NET BENEFIT RELATIVE TO NO PROGRAM[†]
(billions of 1975 dollars)

[†]Excludes potential international relations effect

Figure 6



Statement by Barry Bosworth
Research Associate, Brookings Institution*
before the
Congress of the United States
Subcommittee on Energy and Power
Committee on Interstate and Foreign Commerce
May 26, 1976

I wish to thank the Subcommittee for the invitation to comment on the use of loan guarantee programs to promote growth in energy supplies. While I am aware of most of the issues, I wish to make clear that I am not particularly knowledgeable in the energy area and I wish to limit my remarks to the economic effects of loan guarantee programs. Thus, I will only consider the issue of loan guarantees versus other incentive programs without addressing the first issue of whether or not the proposed plants should be built. In this regard our previous experience with loan guarantees may be of value to the Subcommittee. This specific issue is closely related to my own research interest in financial market structure.

• First, the decision to provide special incentives in the energy area must be seen as reflecting a tradeoff with other claims on the Nation's resources. If more resources are moved into the energy area, less will be available in other areas of private investment, consumption, and government expenditures.

— If this is done through preferred access in the capital markets, the offsetting reductions would

*The views expressed are my own and are not necessarily those of the officers, trustees, or other staff members of the Brookings Institution.

come from other investment -- primarily housing and higher risk loans to small business.

- In contrast, direct budgetary financing would concentrate the offsets in other government expenditures and current consumption.
- The fact that these programs might create jobs is irrelevant to this particular decision, since such a statement is true of any economic expenditure and is not a basis for favoring one over another.
- At the same time, it is unrealistic to believe that such a program will have a serious disruptive influence on capital markets.
- Second, the simple existence of a loan guarantee program does not necessarily increase the total amount of investment in the subsidized area.
- It is very hard to exclude projects that would have been undertaken in the absence of a guarantee, and the guarantee may be exhausted by these projects.
- Such substitution effects have caused serious problems for student loan guarantees and some parts of the home mortgage market.
- Because the administrator of such a program fears recriminations in the event of default the actual risk criteria may be no easier than that of the private market.

- Thus, a loan guarantee program will automatically take over the whole market, and its maximum size must exceed the amount of investment that would have occurred in its absence if any incremental increase in effort is to result.
- Third, a loan guarantee encourages the termination of a project at an earlier date than without a guarantee.
 - For example, assume operating costs are \$10/barrel of oil equivalent and that fixed capital costs at \$10/barrel require a price of \$20/barrel. Without a guarantee, the plant will make a profit at \$20/barrel; but, more important, it will continue to operate at any price above \$10/barrel (operating costs) until the fixed capital plant is exhausted as a means of minimizing the loss.
 - However, with a guarantee the firm will default at any price below \$20/barrel and leave the government with the problem of operating the plant.
 - Alternatively, either price guarantees or government financial participation avoid this problem of premature shutdown.
- Fourth, in combination with current tax laws, a loan guarantee program can seriously distort incentives and become a tax haven rather than a viable economic operation.

- For example, a 90 percent loan guarantee together with a 10 percent investment tax credit results in zero owner equity after the plant is constructed.
- If at any time the owners' equity becomes negative, the rational investor will default.
- In future years rapid tax depreciation and depletion lowers the critical level of the loan guarantee even further.
- Since many of the knowledge benefits are likely to accrue in the construction phase and first few years of operation, there is a strong likelihood of default before the loan is repaid.
- Such a problem of loan defaults was serious for some parts of the federal housing program, and there is no reason to think that businessmen are less rational than homeowners.
- Thus, it will be very important to insure that any combination of loan guarantees, tax measures, and construction loans maintains a substantial amount of owner equity in all years of the project.
- Such projects are likely to be most attractive to public utilities.
- Rate of return regulation allows the cost to be folded into the rate base.

- The opportunity to have a guaranteed source of supply is likely to be of more concern than costs, since the risks of being cut off from natural gas supplies in the future are reduced.
- However, a program to reduce the risk position of the public utilities is not consistent with efforts to explore uncertain costs of new energy sources.
- Therefore, regulated public utilities should probably be excluded from such a program.
- I believe that the most realistic view of these projects is not that they are simply of high risk, but rather there is every expectation that the first few will be unprofitable.
- For a few industries they are attractive as a guaranteed source of supply — particularly regulated utilities where cost is not of primary concern.
- But, for others, the problem is most similar to that of infant industries where those who follow will benefit from the learning aspects of the first. In such a case, an effective stimulus of these new technologies, if desired, will require a direct government contribution to costs rather than just a loan guarantee.

- A clearer insight into the risk problem can be obtained by consideration of three alternative cases.

- Case I: The project is profitable at mean expected future prices but there are risks of price declines.

In this case a loan guarantee simply encourages a premature shutdown at any price below total unit costs instead of continuing to operate at prices above variable costs. The investors are protected against loss but the project is not continued.

On the other hand, price guarantees eliminate this type of risk.

- Case II: The project is unprofitable at the expected price.

Normally, the project would not be undertaken but might be with a loan guarantee with an intention to default because the returns are positive in the first few years because of tax or knowledge benefits.

- Case III: The risks result from uncertainty about costs rather than prices.

Again, a loan guarantee results in default and premature shutdown; but, in addition, a price guarantee is inappropriate. In this case, only direct government participation in the costs will reduce risks. Any use of adjustable price guarantees begins to look like cost plus contracting.

- In practice, any project is likely to be a mixture of these cases, but in no case is a loan program

an appropriate response to risky projects. It encourages their beginning but it also encourages their early termination.

— Loan guarantees are usually designed for situations -- such as home mortgages -- where the costs of gathering information about many small lenders is very high and where a pooling of many loans reduces risks and allows for the use of average default experience as a means of charging an insurance fee. This is not the case for a few large projects where the private market knows as much or more than the government.

- The fact that these are large projects does not itself create a need for a guarantee since U.S. capital markets have frequently been able to meet such needs in other areas with participatory financing.

In summary, I am most concerned that loan guarantees will significantly reduce incentives to develop viable production processes because of premature decisions to quit, limited owner equity, and their potential use as tax havens. In addition, I think it undesirable to place further burdens upon the capital markets as the means of directing resources to the energy field.

— Direct government loans financed out of tax revenue would reduce competition with other capital projects. But they would also involve

the problem of perverse incentives when investors can avoid the risks.

- Price guarantees seem to be the most direct response to the issue of future price uncertainty, but they should include a buy-out feature based on the value of the remaining capital. Otherwise, the government might be committed to subsidizing high cost energy if alternative sources result in much lower than expected future prices. Such a price guarantee must be equal to or less costly than a loan guarantee over the life of the project.
- The problem of cost uncertainty can only be met by a sharing of capital and operating cost through a joint venture as was done for the nuclear programs.
- Loan guarantees, construction grants, and other subsidies to capital costs can also seriously distort the evaluation of the most economic technique when choosing between those which are capital-intensive (subsidized) versus operating cost-intensive (unsubsidized).

Finally, I wish to emphasize that my remarks are directed only at the alternative means of subsidy and not the desirability of the overall venture. I am primarily concerned that loan guarantees result in significant distortion of incentives since they are of value only

in case of failure. A loan guarantee is of minimal value to the most viable projects and of great value to the most doubtful. I am not convinced, after consideration of tax advantages and the accrual of knowledge in the early years of the project, that sufficient owner equity will remain to insure repayment of the loans. I believe that price guarantees and financial participation by the government more directly address the issue of risk without distorting incentives. At present, however, the proposed form of the price guarantee proposal is too vague to judge its effect.

I would oppose the construction grant to public utilities since it encourages vertical integration of a natural monopoly and is an inappropriate special response to a general industry problem of debt capacity. Unless financed by a tax on users such grants artificially lower energy prices and discourage conservation.

Prepared Statement of D. Laird Willott
Before The
Subcommittee on Energy and Power of the
Interstate and Foreign Commerce Committee
U.S. House of Representatives
May 26, 1976

Mr. Chairman and Members of the Committee:

My remarks today are offered in the context of the stated general national policy of the Federal Nonnuclear Energy Research and Development Act of developing, on an urgent basis, the technological capabilities to support the broadest range of energy policy options through conservation and use of domestic resources. We believe that government, business and consumers should join to foster the development, with all deliberate speed and resolution, of additional energy supplies from all possible sources.

In discussing the need for the proposed Federal support and loan guarantees in H.R. 12112, I will limit my comments primarily to a particular area of my firm's experience which is the financing requirements for commercial size demonstrations of high Btu coal gasification technology. The development of this technology has certain characteristics in common with certain proposed demonstrations of oil shale technology with which we are also familiar.

My personal predisposition would be to avoid Federal financial support and loan guarantees for the development of synthetic fuels, including commercial size high Btu coal gasification and oil shale projects. However, based upon the characteristics which affect the financial viability of these projects, the financial characteristics of the regulated natural gas companies sponsoring coal gasification projects and current regulatory attitudes, we have concluded that the

Federal financial support and loan guarantees envisioned in H.R. 12112 will be necessary to accomplish the financing of these project.

Coal gasification and oil shale facilities possess several characteristics which affect their financial viability. These characteristics include:

- untested technology for projects of the size contemplated;
- relatively long construction periods, lasting several years;
- a very high level of capital intensity;
- regulatory decisions; and
- dependence on mining for conversion feedstock, which is subject to environmental restrictions.

The regulated natural gas industry is the primary sponsor of high Btu coal gasification projects. The unique characteristics of this industry which, in combination with the project's financial characteristics, limit the ability of gas companies to undertake these projects include the following:

- companies within the regulated natural gas industry have not been able to accumulate sufficient capital, especially equity capital, nor have they been allowed to earn a return on their existing assets which would enable them to take the type or degree of financial risks inherent in coal gasification projects; and
- declining reserves and curtailments of natural gas have adversely affected the ability of the natural gas industry to attract long term capital.

In order for commercial size synthetic fuel projects to compete successfully for capital funds, we believe that prior to

the commencement of construction, financially acceptable assurances must be given to potential lenders that the projects will be completed and placed into service or, if not, that their loans will nevertheless be repaid under all circumstances. The magnitude of the capital requirements for these projects, the major risks associated with them, and the existing financial structure of the regulated natural gas industry all combine to make it impossible to satisfy the lenders' assurance requirements. It is particularly apparent that the proposed Federal loan guarantees are required in this area for high Btu coal gasification projects.

In our judgment, the government should be given reasonable assurances that its loan guarantees will not be called upon if the projects are completed and placed into operation; similarly, we believe that equity investors must be provided with financial incentives commensurate with project risks to induce their participation. For these assurances and incentives to be met, especially for coal gasification projects, it is our opinion that all events, full cost-of-service tariffs must be approved and implemented by the appropriate regulatory authorities on both the national and local levels. These tariffs will be designed to assure potential lenders and equity investors that gas consumers will provide sufficient cash flow to operate the project and service capital. These tariffs will also help to assure the government that its support during a project's operating period is principally a contingent backstop to consumer commitments.

Federal loan guarantees as a contingent backstop to the consumer

tariff arrangements are needed during a project's operating period because of the historical attitude of the Federal Power Commission towards all events, full cost-of-service tariffs, the current opposition of many state regulatory commissions to provisions which would enable the tracking of such tariffs, and the risks that regulatory authorities, courts or legislatures could take, or be required to take, many subsequent actions that would compromise or eliminate initial regulatory approvals of such tariff support.

We believe that the proposed government guarantee of debt, in combination with gas user tariff support and project sponsor support in the form of equity investments, is an appropriate method by which to accomplish the financing of commercial size coal gasification facilities. In our opinion, this combination will satisfy the repayment assurances of institutional lenders during both the construction and operating periods. It should be recognized that institutional lenders are expected to provide a substantial portion of the requisite capital and that they act in a fiduciary capacity. In such capacity, they are charged with the protection of the funds of their beneficiaries, the saving and investing public. To the extent that they perceive a greater degree of risk in one project relative to the many other investment alternatives available, they cannot be expected to advance funds to that project. Furthermore, in many instances state laws impose requirements and limitations on the type and degree of investment risk they can take.

We would now like to comment upon specific provisions in the proposed legislation.

The mandate given by H.R. 12112 mounts a very broad attack on the energy problem. It represents a very comprehensive undertaking with almost unlimited possibilities for research and development and, if well done, should result in extensive benefits to the country as a whole. The most important aspect of H.R. 12112 is that it gets the job started--the job of developing energy technologies, including synthetic fuel technologies.

The current version of H.R. 12112 authorizes loan guarantees of up to \$2 billion in 1977 and \$2 billion in 1978 with a limit on guarantees to be made available to high Btu gas development of 50% of these amounts. These authorized amounts appear to be adequate to get high Btu gas programs under way. However, I must point out that the effort mounted by HR 12112 will of necessity extend over many years and will in all probability require ongoing support for some years for several reasons:

(A) H.R. 12112 covers a very wide range of energy technologies which could be fostered and developed.

(B) A commercial size demonstration facility for the envisioned energy technologies will be very costly. One high Btu coal gasification project of commercial development size could cost, even on a minimum basis, approximately \$1 billion over a several year construction period. Construction cannot commence until all financing is arranged, and such arrangements cannot be obtained without sufficient guarantees.

(C) The financing of the essential community planning and development costs resulting directly from the demonstration facilities

could utilize a significant amount of the guarantees available. Additionally, to the extent that an applicant for assistance for a commercial demonstration facility would have to advance sums to states, political subdivisions or Indian tribes for this purpose, these payments would have to be added to the cost of the applicant's facility and funded as part of the overall financing plan for the facility. In our opinion, it will be necessary for these payments to be guaranteed because they are subject to the same risks as the other capital invested in these projects. Tax abatements do not necessarily represent a source of capital to finance these payments because they are not realized without sufficient earnings to utilize them.

(D) The extensive number of approvals and consultations necessary for each project will involve substantial amounts of time which, during periods of inflation, will add to the cost of the demonstrations and thereby could adversely affect their economic viability.

As a general comment, there is one additional financial incentive outside the guarantee area which I believe would be helpful to financing synthetic fuel and other energy projects. This lies in the area of additional tax incentives. Many projects will generate large investment tax credits which, to the extent the credits can be utilized to reduce Federal income taxes payable, could provide additional capital funds to finance project construction. However, because of the potential size of the credits and because of the general tax limitation that such credits can only be utilized to a maximum of 50% of taxes payable, many of these credits may not be

used as they become available. To assure that such credits can be utilized to provide additional capital funds, I would recommend that in the case of activities of the nature to which H.R. 12112 is addressed, the tax laws be amended to allow the full use of project tax credits up to 100% of sponsor taxes payable.

As to the potential impact of the government assistance proposals on our capital markets and economy, we previously testified before the House Committee on Science and Technology that, in our opinion, a \$6 billion program spread over the construction periods contemplated for synthetic fuel projects would not be expected to disrupt the capital markets when considered against the historical amounts of capital raised by the private and public sectors. We are still of that opinion for the proposed program. We also believe that the economy would benefit significantly from such a program principally because of the overriding importance of energy to our country's economic health.

When trying to measure the impact of any guarantee program, it is important to realize that there are many factors which cannot be accurately predicted and which will materially affect future capital markets. These factors include: the capital requirements of the public sector (Federal, state and local governments), especially those requirements arising from deficit spending; the capital requirements of the private sector; government monetary policy; taxation policy; rates of inflation; savings rates; international balance of payments; and industrial efficiency and productivity. Because

these factors are unknown, it is impossible at this time to predict with any real accuracy what the size of the capital markets or the total demand for capital funds will be over the next decade.

Estimates of the capital expenditures for the energy related industries in the next several years are extremely large by historical standards. Unless necessary tax and other incentives are implemented, current trends would indicate that internally generated funds for these industries will fall short of funding their historical share of capital expenditures. The balance of these requirements for funds must be met by external financing.

The government guaranteed securities issued in connection with any energy program would compete principally with the highest grade corporate debt securities. The net amount of all corporate debt securities issued during the five-year period from 1971 through 1975 was approximately \$113 billion. Based upon the size of this market, we believe that the proposed \$4 billion loan guarantee program would not have an adverse effect on the corporate debt market in general or on the ability of either the energy or non-energy industries to raise capital in the next decade.

Any government guarantee program, however, should not be taken too lightly, especially if it is assumed that additional guarantee authorizations will be approved under H.R. 12112 and other energy programs. The ability of companies with lower credit ratings to compete for available capital could be lessened at times. In addition, higher grade corporate debt securities could face slightly

higher interest rates in order to compete with an increased supply of government guaranteed debt.

The provision in H.R. 12112 which specifies that the concurrence of the Secretary of the Treasury must be obtained with respect to timing, interest rate and substantial terms and conditions of any guarantees should prove most helpful in minimizing any impact of the proposed program on the capital markets.

In summary, the availability of proposed loan guarantees should further the general objectives of the Federal Nonnuclear Energy Research and Development Act and hence should facilitate the development of additional energy sources to meet the country's needs.

I appreciate the opportunity to appear before your Committee and will be pleased to respond to your questions.

Appendix A
Dillon Read Statement before
the Subcommittee on Energy
and Power of the Interstate
and Foreign Commerce Committee,
May 26, 1976

Biographical Sketches

D. Laird Willott began work with Dillon Read as a corporate finance associate in 1966. In 1969, he was elected a Vice President, and in 1975, he was elected a Senior Vice President. Mr. Willott specializes in the energy and natural resource industries and is responsible for several of the firm's clients in those areas. In connection with these industries he has concentrated on project financial planning.

With Mr. Willott at the hearing is Michael R. McClurg whose biographical sketch follows.

Michael R. McClurg joined Dillon Read in 1971 as an associate in the corporate finance department. In the following year, he was elected a Vice President. Most of his time with the firm has been devoted to the development of financing plans for energy related projects and activities. These projects include the high Btu coal gasification facilities sponsored by American Natural Resources Company and Panhandle Eastern Pipe Line Company, an oil shale project for a major oil company, a naphtha based synthetic gas project for a major gas distribution company, and a nuclear fuel enrichment joint venture between a major oil company and a technologically based industrial company.

Business of Dillon, Read & Co. Inc.

As a firm, Dillon Read has worked for many years with the regulated natural gas and the petroleum industries, providing general investment banking services including financial advice as to specific energy projects such as those involving synthetic fuel production. For example, Dillon Read is financial advisor to the American Natural Resources Company on its proposed high Btu coal gasification project. We also have been retained by Panhandle Eastern Pipe Line Company to advise them with respect to a proposed high Btu coal gasification project. Through our investment banking relationship with Texas Eastern Transmission Corporation, we have been indirectly involved with the Western Gasification Company high Btu coal gasification project. In addition, we have performed certain financial advisory services in connection with a major oil shale project.

Dillon Read has had a long and continuing association with the natural gas industry. Since 1946, when the industry began its development as a major supplier of energy, Dillon Read has raised in excess of \$4.7 billion of capital for the industry. During the past five years, Dillon Read managed the sale, either publicly or privately, of \$1.4 billion of natural gas company securities. Dillon Read also has completed negotiated financings and/or has acted in a financial advisory capacity to several companies in the oil industry. Over the past five years the firm has managed or co-managed a total of \$2.8 billion in negotiated security offerings for its natural gas and oil company clients.

The principal activities of the firm include the development of financing programs; advice on appropriate capital structures; review and appraisal of capital markets; advice on design, amounts and timing of underwritings and private placements; organizing and managing syndicates of leading investment banking firms to underwrite issues; the private placement of securities and a wide variety of financial advisory services including corporate reorganizations and mergers and acquisitions. Dillon Read's record of negotiated financings for corporations, municipalities, and governments is summarized below for the five-year period 1971-1975:

	<u>Total 1971-1975</u>
Corporate Securities	
Public Offerings	\$ 6,133,000,000
Private Offerings	<u>1,312,000,000</u>
Total Corporate Securities	7,445,000,000
Municipal and Governmental Securities	<u>2,846,000,000</u>
Total Negotiated Securities, 1971-75	<u><u>\$10,291,000,000</u></u>

Appendix B

Dillon Read Statement before the
Subcommittee on Energy and Power
of the Interstate and Foreign
Commerce Committee, May 26, 1976.

Financial Characteristics of High Btu Coal Gasification Projects

The financial characteristics of high BTU coal gasification projects is important to understand because it provides a basis for determining the need for government assistance on projects that are to be undertaken by the regulated natural gas industry.

The most important elements of high Btu projects for financing purposes are:

- (1) The capital requirements involved.
- (2) The major risks and problems associated with such projects.
- (3) Federal Power Commission decisions and principles.

Capital Requirements Involved

Perhaps enough has been written and spoken about the vast technological and developmental costs of the large-scale synthetic energy projects of the next few years, but, the very magnitude of the price tag is a critical element in the ability to finance the job. The costs of these super projects relative to the historical costs of the sponsoring companies' in-place plant, as well as the depreciated book value of their existing plant facilities is significant. For example, a \$1 billion coal gasification project represents approximately 40% and 33% of the original cost of the plant, property and equipment of American Natural Resources Company and Texas Eastern Transmission Corporation, respectively, as of

December 31, 1975. It also represents approximately 56% and 51% respectively of the depreciated book value of all of their property, plant and equipment.

It should also be carefully noted that despite the tremendous size of these gasification plants, the incremental gas supplied by one of these projects will be relatively small in comparison to the current deliveries of either American Natural or Texas Eastern. It is this inverted relationship, the requirement of huge capital commitments to provide relatively small amounts of incremental gas to existing systems, which poses critical financing problems.

Major Risks and Problems

The major risks and problems associated with commercial sized high Btu coal gasification projects, which could adversely affect the economic and financial feasibility of such projects, and which would be of concern to potential investors and thus must be recognized in the financing arrangements, can be separately considered as those arising during the construction period and those arising during the operating period.

Construction Period Risks and Problems

Completion poses perhaps the most difficult of all problems attendant to the financing of these projects. The potential

purchasers of debt securities are not in a position to make accurate judgments as to technological, construction, regulatory, environmental, or inflationary risks. These investors will require protection against such risks through a financially acceptable assurance that the projects will be completed and placed in service within a prescribed amount of time, or if not, that their investments will be recovered.

The major risks associated with the completion of these projects that are of concern to potential investors are:

(1) Gasification Process

The gasification process selected for use in the first of these proposed commercial size projects is known as the "Lurgi Process." Investors will recognize that the Lurgi Process has been commercially proven for the manufacture of medium Btu gas, and the methanation process to increase the Btu content to the desired level has been successfully demonstrated. However, there are no commercial sized gasification plants in operation in the United States, and there are no plants in operation anywhere in the world which are as large as those contemplated by certain companies in the regulated natural gas industry. Until the Lurgi Process is commercially proven in the United States, the opinion of qualified engineers will provide the sole assurance of its physical capability. Although reliance on the opinion of qualified engineers is not unprecedented for financing certain projects or activities of relatively proven capability or moderate cost, we believe that potential investors will not rely solely on such opinions as a basis for committing

funds primarily because of the status of the gasification technology and the relative and absolute dollar size of the projects.

(2) Potential Time Delays and Cost Overruns

These projects entail a potential for time delays as a result of the complexity of the gasification plant, the regulatory and environmental proceedings, and the long lead time required for planning, engineering and construction. Any time delays could lead to cost overruns, as would an increase in the rate of inflation beyond that incorporated into the financing plans. The risk of cost overruns is magnified by the relative and absolute size of the capital requirements.

(3) Capital Intensity

As stated above, these projects are highly capital intensive. The combination of the high capital intensity and the long lead time compounds the risk of delays and cost overruns.

(4) Nature of Construction

The nature of constructing these projects, particularly the gasification plant component, is such that it is not feasible to minimize the risks by a step-by-step construction process which would prove the gasification process before the full project investments are made. Once a substantial commitment is made and the long construction period is begun, there is no alternative to completion of the entire project except abandonment.

Operating Period Risks

The major risks associated with the operating period of these projects that are of concern to potential investors are:

(1) Government Action

Federal, state or local government action might be taken in a number of ways which would preclude the economic operation of the projects. For example, adverse strip-mining legislation might result in the termination of the coal supply for the gasification plant, thus preventing operations. Environmental legislation might be adopted making continued operation of the projects infeasible or the cost of production so high as to make the gas unsaleable.

(2) Regulatory Action

Despite acceptable initial approvals, which to date have not been granted nor is there any indication that they can be obtained, federal, state or local regulatory authorities, courts or legislatures could take, or be required to take, many subsequent actions that would not permit the projects to earn their full cost of service and would therefore impair or eliminate the ability to assure the amortization of project investment.

(3) Force Majeure

The projects could experience damage or interruption of operations due to non-insurable risks such as wars, strikes, explosions and acts of God. If such events impair the operations of these projects for any significant time, there would be insufficient cash flow to service financing.

(4) Competitive Pricing

Investors would be concerned about such factors as the development of new, cheaper domestic sources of energy or reductions in costs of foreign supplies, as well as the possibility of changes in the Federal government's position regarding reliance on foreign imports. If any of these possibilities occur, the cost of gas produced by these projects could become non-competitive which in turn could mean that the gas could not be sold at prices sufficient to service financing. This risk would be significantly reduced if regulatory approvals could be obtained on a basis that provided for full cost of service pricing.

Federal Power Commission Decisions and Principles

The economics of coal gasification and the ability to arrange the financing will be very much dictated by Federal Power Commission ("FPC") decisions on substitute natural gas, including coal gasification. To date, the FPC decisions have established certain basic principles on jurisdiction, pricing, and sale of "substitute" and "new source" gas in interstate commerce. The applicable FPC decisions are contained in Opinions Numbers 622 (issued June 28, 1972), 622A (issued October 5, 1972), 637 (issued December 7, 1972), 637A (issued February 6, 1973), 663 (issued September 4, 1973), 728 (issued April 21, 1975), and 728A (issued November 21, 1975).

Based on a review of the aforementioned opinions, the FPC established principles for coal gasification can be summarized as:

- (1) Coal gasification plants produce "artificial gas" within the meaning of the Natural Gas Act (the "Act").
- (2) The Act does not vest the FPC with jurisdictional powers over artificial gas (SNG); therefore, the coal feedstock, the gasification plant, the facilities for the transportation of the SNG when unmixed with natural gas and the sale of SNG when unmixed with natural gas are not within the jurisdiction of the FPC.
- (3) The Act does vest the FPC with certificate authority over the facilities necessary to permit the mixing of SNG with natural gas, over the transportation facilities and any applicable transportation rate after mixing, and over the rate at which the SNG is sold for resale in interstate commerce after mixing with natural gas.
- (4) In Opinion Number 728A, the FPC has conditioned its selling price authorization for SNG projects to a maximum fixed price which will apply to all SNG produced after project completion and during the testing operations. Thereafter, subsequent prices would be established in Section 4 pricing procedures before the FPC; such pricing procedures include a minimum bill provision which provides a method for recovering capital invested and return on equity except for sliding-scale penalty provisions that operate if SNG quantity and BTU content fall below certain levels.
- (5) Although deferred for future consideration in Opinion No. 728, the FPC has applied "incremental" rather than "rolled-in"

pricing to SNG in prior decisions.

- (6) Although not directly enacted for coal gasification projects, the FPC has established curtailment policies based on end-use priorities, which rank large commercial and industrial requirements behind residential and small commercial requirements.

Discussion of Federal Decisions

The FPC curtailment policies are at odds with the prescribed policies for pricing SNG when mixed with natural gas. This makes it difficult to imagine that large commercial and/or industrial users would be willing to sign long-term SNG purchase contracts, at incremental prices designed to support the gasification project financially, when such supplies could be curtailed for higher priority uses.

When totally considered, the FPC decisions and policies summarized above would not permit the arrangement of debt capital for project financing prior to the commencement of construction. The debt capital could not be arranged even if a project sponsor were willing to make substantial equity commitments and debt guarantees because the FPC decisions and policies subject a project sponsor to so many large risks, particularly given the large capital costs involved, that he may not be able or willing to commit the full amount of equity or guarantee required to satisfy lenders that a project could be completed, or if not, that the debt could be repaid.

Even with the minimum bill provision included in FPC Opinion No. 728A, it will not be possible to arrange project debt without additional financial guarantees and assurances. The minimum bill provision would not commence until a project produced gas. While such a pricing mechanism may provide a method of recovering funds invested in a project after operations have commenced and gas production has begun, we do not believe that it provides a basis for raising (as distinguished from recovering) capital to construct and complete a project. The minimum bill provision does not provide a basis for assuring lenders that a project can be completed (so that operations and gas production can commence), or if not, that their investments will be recovered. Further, there is no method of assuring lenders that the minimum bill provision for recovering investments would be maintained by future Federal Power Commissions over the operating life of a project.

Need for Governmental Assistance

Attempts to cope with the financing problems of high Btu coal gas projects have included consideration of all events, full cost of service tariffs to assure debt service and surcharges on present customers to provide a portion of construction costs. Regulatory bodies have thus far been unwilling, in part because of the risks involved, to permit these tariff arrangements. In addition, further assurances will be required as to completion, production of gas, and its transportation and sale.

Initial regulatory approvals will not be sufficient as subsequent actions of regulatory bodies cannot be predicted. Institutional lenders, primarily insurance companies and pension

funds who would be expected to provide a substantial portion of the debt capital, act in a fiduciary capacity and are charged with the protection of their beneficiaries' funds. State laws impose requirements and limitations on the degree of investment risk that can be committed by institutional lenders. These lenders' requirements cannot be satisfied by relying solely on the cost of service tariffs or the credit of the sponsoring companies.

The huge capital requirements of these projects, the major risks and problems associated with their construction and operating periods, and the FPC decisions issued to date on such projects, in combination with the financial structure and characteristics of the regulated natural gas industry discussed in Appendix C, make it impossible for these projects to be financed in the absence of government loan guarantees as proposed in H.R. 12112.

Appendix C
Dillon Read Statement before
the Subcommittee on Energy
and Power of the Interstate
and Foreign Commerce Committee,
May 26, 1976.

Financial Characteristics of
Regulated Natural Gas Utility Companies

To understand the financial characteristics of regulated natural gas companies and to appreciate their current inability to undertake the costly construction of commercial sized high Btu coal gasification projects, it is necessary to examine the Natural Gas Act and the overall evolution of the industry.

In essence, the Natural Gas Act was an attempt to regulate the natural gas industry on a basis comparable to the electric utility industry under the Federal Power Act; that is, the Natural Gas Act was intended to ultimately place the pricing of gas under a utility-type framework. At first regulation only was applied to the natural gas pipeline companies. With the passage of time, however, it became apparent that as the unregulated wellhead price of gas began to increase, regulation of natural gas pipeline companies did not fully accomplish the intended purpose of a utility type pricing structure for gas. For this reason, the courts decided in the Phillips Case that regulation of the wellhead price of gas was necessary. Consequently, in 1954, regulation was substituted for supply and demand in determining the price at which the interstate pipeline companies could purchase natural gas.

Under regulation, gas prices have been set at levels which make it extremely cheap relative to other forms of energy. This has caused both the demand for and the consumption of gas to increase rapidly. As supplies of low priced gas have been depleted, additional reserves have not been developed in amounts sufficient to offset higher consumption; as a result, shortages and resulting pipeline curtailments have arisen. Furthermore, available gas in unregulated intrastate markets is priced far above the maximum level which interstate pipeline companies are permitted to offer thereby contributing to additional shortages in interstate markets.

Despite these problems, however, the transmission industry historically was regarded by investors and lenders as possessing financial characteristics which were favorable for investment for several reasons.

First, the industry was built and financed on huge gas reserves which represented a cheap source of energy.

Second, the industry expanded at a substantial rate primarily because the regulated low price of natural gas created enormous demands. This rapid expansion in customers and consumption during the period from the end of World War II until the early 1970's formed a solid foundation for debt and equity financing.

Third, the pipeline industry traditionally has been a regulated industry both on the national level through the Federal Power Commission ("FPC") and on the local level through state regulatory authorities. While regulation has created many problems for the industry, it has provided an implied obligation for reasonable returns of and on invested capital which has given assurances to lenders and equity investors alike with respect to debt repayment and rates of return on equity.

Fourth, during the 50's and 60's the industry operated in a period of what would be regarded today as relatively healthy and stable capital markets. Capital funds were available, interest rates were low, and public and institutional demand for gas company securities was high. These factors, in combination with FPC and state rate making procedures which seek to minimize capital costs and overall gas costs, led gas companies to utilize relatively large amounts of long-term debt in their capital structures because the after-tax cost of debt generally is much lower than the after-tax cost of equity.

Finally, the principal business of natural gas companies was the construction and operation of pipeline systems employing relatively low level technology for the transmission and distribution of natural gas. Activities outside the shipment of gas,

such as exploration or development, were not a major element or area of capital commitment in the industry as it traditionally evolved, and thus it became identified as an industry of generally low risk.

In contrast, the industry currently is facing rapidly changing circumstances which are affecting its operating structure and financial viability. For example, in a matter of a few years, the gas supply of the industry has changed from a surplus situation to a reserve deficient status. Reserve life indexes continue to decline, to something less than ten years supply if Alaskan gas is excluded. The declining reserve picture, more than any other single factor, has caused lenders and investors to reexamine the traditional financing patterns of the industry and has prompted them to modify their investment policy. As a consequence, the industry has virtually stopped expanding. It is currently regarded as a mature industry, forced to curtail customers in the face of shortages and significant unused pipeline capacity. Caught between sharply higher capital and operating costs and the reluctance of regulatory authorities to increase service rates and gas costs precipitously, the industry is faced with a skeptical investment community. Lenders and equity investors alike are questioning the industry's

ability to meet its high level of debt commitments plus provide a reasonable return on equity. This is especially true in connection with the highly capital intensive synthetic fuel projects that currently are being proposed.

Coupled with these changes has been the deterioration in the capital markets which has resulted not only in tighter money and higher interest rates in general, but also in the overall shortening of maturities and increased sinking fund requirements for gas company debt securities in particular. Also, as a consequence of adverse conditions in the capital markets, recent corporate bankruptcies and local government financial crises, the question of credit has become all important. The ability to finance and raise capital at all is now a matter of credit standing, and there are companies, entire industries as well as selected governmental entities, which at certain times are not able to secure financing at any cost. Under these conditions the higher leveraged and lower credit companies and industries, such as the regulated natural gas industry, are forced to compete on disadvantageous terms with other borrowers, and at times they are foreclosed from substantial portions of the capital market.

Finally, on top of these deteriorating financing characteristics, the regulated natural gas industry has been forced by

circumstances to assume an entirely new role, that is, seeking and developing its own supplies of gas. Exploration and development has traditionally been an adjunct of and financed by other companies outside the regulated natural gas industry. At this point in time, however, the regulated natural gas industry, with enormous commitments in facilities and increasing requirements to maintain existing gas deliveries, is faced with obtaining adequate supplies by its own efforts and financial commitments. In this regard, the industry has made advance payments to producers in excess of \$2 billion. In effect, advance payments are interest free loans which are used to explore for and develop new gas reserves. The gas companies are able to collect the carrying cost of these payments through their rates, but they also use a large portion of their capital raising capacity in securing funds for such payments. As of December 31, 1975 the Federal Power Commission terminated the advance payment program so that any future gas company financial arrangements with producers will not be provided any assured basis for collecting the carrying costs of such arrangements through gas prices. This fact will force the gas companies to undertake higher risk financial commitments in an attempt to obtain additional gas supplies. Given the financial structure of the gas companies, the increase in financial risks may be so large as to preclude the undertaking of alternative

financial arrangements to the now defunct advance payment program; this is particularly true given the prospect that nationwide allocations of gas supply could be mandated.

In addition, regulated gas companies have sought to augment their gas supplies through such other means as direct exploration activity and liquefied natural gas projects, and currently they are contemplating synthetic gas production from coal. Because of the high leverage and regulated nature of the industry, however, natural gas companies have never developed a capital structure capable of taking large scale exploratory or experimental risks for new sources of gas. A regulated return structure has not been conducive to building an excess equity base or large cash reserves which could absorb the risk of complete loss associated with the new sources of gas supply. Moreover, this risk is not offset by a potential for greater rewards in the event of economic success or excellent management because the rate of return on equity is limited by regulatory inflexibility.

Although all of these elements have contributed to the generally reduced capital capacity of the regulated natural gas industry, it is the overall increase in the cost of doing business that imposes the most significant questions. In this regard, no element has contributed more to the uncertainty of financing capability than inflation. This is especially true in connection with the highly capital intensive commercial sized coal gasification projects that certain companies are sponsoring at this time. In short, the ability of any industry, and in particular the

regulated natural gas industry, to finance huge synthetic fuel projects in vastly inflated dollars, based on a plant and financial structure of highly depreciated dollars, is exceedingly problematic. For the regulated natural gas industry, which has been traditionally highly leveraged and regulated as to equity return, the task is especially onerous. Other lower leveraged and non-regulated industries may be able to handle inflation by both increasing their leverage as well as achieving higher rates of return on risk capital. The regulated natural gas industry has no flexibility with respect to increasing its debt leverage and is effectively precluded by regulatory restrictions from obtaining higher returns on risk capital. To this extent the industry is penalized in the capital market arena.

Comparison of the Ten Largest Natural Gas Companies (1)
(Dollars in Thousands)

Ten Largest Natural Gas Companies	Total Operating Revenues	Earnings Available to Common	Total Debt (2)	Total Preferred Stock	Total Common Equity	Total Capitalization (3)	Total Debt as a % of Total Capitalization
Columbia Gas System, Inc.	\$ 1,443,140	\$102,665	\$ 1,516,496	\$100,000	\$ 962,845	\$ 2,579,341	58.8%
Texas Eastern Transmission Corporation	1,312,033	106,819	1,290,318	138,036	762,875	2,191,229	58.9
American Natural Resources Company	1,044,946	101,980	1,229,553	50,000	709,360	1,988,913	61.8
El Paso Company	1,389,355	58,211	1,359,570	-	529,540	1,889,110	72.0
Peoples Gas Company	934,592	96,071	1,042,219	101,553	684,071	1,827,843	57.0
Consolidated Natural Gas Company	970,564	67,735	743,150	50,000	702,007	1,495,157	49.7
Northern Natural Gas Company	1,163,204	127,300	766,083	56,460	650,818	1,473,361	52.0
Transco Companies, Inc.	601,284	44,833	1,009,170	148,366	306,179	1,463,715	68.9
Pacific Lighting Corporation	1,098,285	42,200	820,468	110,091	504,341	1,434,900	57.2
Panhandle Eastern Pipe Line Company	659,284	69,957	892,731	34,960	455,117	1,386,408	64.6
	<u>\$10,616,687</u>	<u>\$817,771</u>	<u>\$10,672,753</u>	<u>\$789,466</u>	<u>\$6,267,153</u>	<u>\$17,229,977</u>	<u>60.2%</u>

Notes:

- (1) Total capitalization was used as the criteria for ranking the ten largest companies in this comparison. Results shown are for the period ending 12/31/75. Tenneco, Inc. has been excluded because less than 20% of the Company's revenues are derived from its natural gas operations.
- (2) Total Debt includes both short and long-term debt and current maturities of securities requirements.
- (3) Total Capitalization excludes minority interests in subsidiaries.

Regulated Natural Gas Industry Capital Expenditures, 1965-1984
(Dollars in Millions)

	Capital Expenditures				
	Conventional Construction Expenditures(1)	Exploration and Development(2)	Foreign LNG(3)	Coal Gasification(4)	Arctic Gas(5)
Historical					
1965	\$ 1,935				\$ 1,935
1966	2,374				2,374
1967	2,252				2,252
1968	2,972				2,972
1969	2,686				2,686
1970	2,507				2,507
1971	2,419				2,419
1972	2,822				2,822
1973	2,966				2,966
1974	2,920				2,920
Total, 1965-1974	\$25,853				\$25,853
Projected (6)					
1975-1979	\$16,700	\$ 5,120	\$4,095	\$ 2,717	\$36,160
1980-1984	18,400	7,990	26	15,000	41,866
Total 1975-1984	\$35,100	\$13,110	\$4,121	\$17,717	\$78,026

Notes:

- (1) Conventional construction expenditures include general construction, underground storage, distribution, transmission, production, propane plant and LNG storage. From 1965-1974, conventional construction expenditures also include expenditures for exploration and development, foreign LNG, coal gasification and gas from the Arctic. Data Sources: A.G.A. Statistics; and IGT Projection.
- (2) Exploration and development expenditures include advance payments to other companies and funding of company owned production subsidiaries. These figures are based on the increased availability of offshore leases in the Gulf of Mexico and future lease sales in the Atlantic, Pacific and Alaskan offshore areas. Data Sources: FPG Schedules 1 (a, b, c) Attachment B, FPG Docket RM 74-4 Order No. 499; and IGT Analysis of Gas Industry Exploration and Development Funding.
- (3) Foreign LNG estimates show the projected capital expenditures for U.S. facilities and U.S. owned LNG carriers; they exclude the capital funds required for foreign facilities and foreign owned LNG carriers. These figures are based on those projects which have filed applications with the FPG. These projects include El Paso 1 and 2, Pacific Indonesia, EAGSOGAS LNG, and Trunkline LNG. When additional ventures are filed with the FPG, the industry's capital requirements will increase. (Foreign investment requirements on these projects currently on file with the FPG are expected to approximate \$5,180 million.)
- (4) Capital expenditures for plants to produce synthetic pipeline gas from coal are based on nine facilities, each with an assumed unescalated plant cost of \$850 million and an associated mine cost of \$450 million, and each with a nominal capacity of 250 MMcf per day. The figures will increase as additional projects are announced but their timing may be retarded because of delays in obtaining regulatory approval and financing, and in meeting projected construction timetables. Data sources: FPG filings; announced projects; and IGT Projection of Expenditures and Project Schedules.
- (5) Arctic gas expenditures are based upon the certification of the Arctic Gas project, inclusive of the Northern Border pipeline; however, expenditures for the gas handling, gathering, compression and condensation facilities to be built on the North Slope of Alaska, and the pipeline facilities running to West Coast markets are not included. (These facilities could approximate an additional \$2,000 million.)
- (6) All projections have been adjusted for future cost increases approximating 6% per year.

Appendix D
Dillon Read Statement Before
the Subcommittee on Energy
and Power of the Interstate
and Foreign Commerce Committee
May 26, 1976.

Comments on H.R. 12112

Section 18 (a) The definition of a "demonstration" facility with respect to a high Btu coal gasification project should envisage a commercial sized facility or process brought to the point where costs, reliability and quality of product are known and where conventional financing becomes possible on a comparable facility. In the case of high Btu coal gasification, a "pilot plant" will not meet these criteria.

18 (b) (1) The authorized loan guarantees should clearly apply to all construction and start-up costs, including all taxes and capital and financing costs.

It is assumed that the \$4 billion of authorized loan guarantees relates to the principal amount of such guarantees. It is also assumed that the guarantees on the debt outstanding on September 30, 1986, will extend to the maturity of such debt.

18 (b) (3) Concurrence of the Secretary of the Treasury with regard to certain terms of the guarantees should be most helpful in minimizing any possible impact on the capital markets.

- 18 (b) (6) The issuance of loan guarantees on the basis of competitive bidding to the extent possible must be carefully approached because of the lack of comparable criterion upon which to judge the merits of alternative projects.
- 18 (c) (7) In the case of a facility planned to be located on Indian lands, the written consent to such location by the appropriate Indian tribe could lead to inordinate delays unless some statutory overriding provision is authorized. (See comment re: 18 (e) (1))
- 18 (e) (1) The ability of the Administrator to proceed with a project by reason of overriding national interest, even though the Governor of a State objects, should be extended to other political entities if the present language does not convey this authority. Financing cannot proceed until all such matters have been satisfactorily resolved.
- Perhaps the right of eminent domain should be included.
- 18 (e) (2) The Administrator should have exclusive authority with respect to a determination of project costs and who should pay such costs. The Administrator's determination should be binding upon the States, political subdivisions and Indian tribes; otherwise, a disparity could result

from those costs recognized by the Administrator and those costs recognized by other entities. This disparity could jeopardize the willingness and/or ability of the sponsor(s) to undertake the project to the extent it must finance this disparity on its own credit.

18 (g) (2), It should be made clear that in the event the loan
(3) and (4) guarantees are invoked, the Administrator's recourse extends only to the project and is subrogated to the rights of the lenders to which the loan guarantees apply.

18 (j) It is assumed that the fees will apply to the average principal amount of outstanding obligations covered by the guarantees.

18 (k) (1) (c) The costs incurred in connection with essential community planning and development will necessarily constitute a part of the total cost of a project. In our opinion, guarantees will be necessary to finance these costs because the capital required thereto will be exposed to the same risks as the other capital invested in a project. Tax abatements are not an acceptable basis for financing these payments because the abatements are not realized without sufficient earnings to utilize them; therefore, they do not

provide a sound basis upon which to depend for recovery of investment.

18 (k) (5) (b) If the Administrator requires that community development and planning costs be included in the cost of a facility such costs should be approved by regulatory authorities for rate purposes in the case of facilities sponsored by regulated public utilities.

18 (w) It is assumed that the language of this subsection does not affect the provisions of 18 (b) and 18 (n) in any way that would compromise honoring the payment of the guarantees or operation of the separate "Fund".

General Comment

It is recognized that a certain number of approvals and consultation would be necessary in order to execute properly the purposes of H.R. 12112. The following are referred to:

Secretary of Treasury -

- a) consultant as to rules and regulations for guarantees
- b) concurrence required as to terms of guarantees with capital market impact in mind

Attorney General -

Federal Trade Commission -

- a) comments on competitive aspects and may make recommendation against

Governor of State -

- a) must evaluate project
- b) may recommend against

Local Political Subdivisions -

- a) may review and comment
- b) receive grants for impact studies, etc.

Indian Tribes -

- a) may review and comment
- b) receive grants for impact studies, etc.
- c) must give written permission

Secretary of Interior -

- a) approve use of Indian lands

Committee on Science and Technology, House of Representatives -

- a) approval of guarantees
- b) receive reports prior to commitment of guarantee

Committee on Interior and Insular Affairs, Senate -

House of Representatives -

- a) together, may reject guarantee

Senate -

Environmental Protection Agency -

Federal Energy Administration -

Department of Housing and Urban Development -

Department of the Interior -

Department of Agriculture -

Department of Treasury -

Advisory Panel -

- a) consultant as to comprehensive plans to implement program

The number of persons or entities involved will, in all probability, require substantial amounts of time which, as a result of inflation, will add to the cost of the demonstrations and could adversely affect their economic viability.

SUMMARY OF TESTIMONY OF
 CHARLES J. CICHETTI, Ph.D.
 DIRECTOR OF THE WISCONSIN ENERGY OFFICE
 Before the Subcommittee on
 Energy and Power of the U.S.
 House Interstate and Foreign Commerce Committee

May 26, 1976

I. A. The Natural Gas Shortage in the Midwest

- B. Federal Loan Guarantees: A necessary step or
 unnecessary federal intervention

II. Other Federal and State Regulatory Matters: The
 American Natural Resources Approach

III. Financing

Environmental (FPC)
 Cost of Service (All Events) Rate
 Wholesale rolled-in vs. Incremental Pricing
 Ratchet rate of return adjustment for Equity
 Allowance for funds used during construction (AFUDC)
 Retail rolled-in pricing
 Distribution company affiliates
 Investment Tax Credit as a Source of Affiliated Equity Finance
 Limited Liability for Distribution Company Partnership

IV. Pricing Non-Historic Gas

Inverted Rates
 White Markets
 Jobs and Economic Prosperity
 Tanstaaf
 Project Risk
 Investment Rules

V. Related Issues

Regulatory changes
 Low BTU gas
 Arctic gas
 De-regulation

ORAL STATEMENT OF
ARTHUR R. SEDER, JR., PRESIDENT OF AMERICAN
NATURAL RESOURCES SYSTEM
BEFORE THE SUBCOMMITTEE ON ENERGY AND POWER
OF THE U.S. HOUSE INTERSTATE AND FOREIGN
COMMERCE COMMITTEE

May 26, 1976

Before the Subcommittee on Energy
and Power of the U.S. House
Interstate and Foreign Commerce Committee
May 26, 1976

ORAL STATEMENT OF ARTHUR R. SEDER, JR.
PRESIDENT OF AMERICAN NATURAL RESOURCES COMPANY
DETROIT, MICHIGAN

My name is Arthur R. Seder, Jr. I reside in Detroit, Michigan, and am President of American Natural Resources Company.

I have filed a written statement with the Subcommittee, which I ask be included in the record. My oral statement will be confined to a very brief review of our coal gasification project and the reasons why we think the proposed Federal loan guarantee program is in the public interest, after which I will try to address some of the questions that have been raised concerning the necessity and desirability of the legislation.

American Natural Resources Company is an integrated natural gas pipeline and distribution system. Our distribution affiliate, Michigan Consolidated Gas Company, supplies gas at retail to over 1,000,000 consumers in Michigan, including metropolitan Detroit and other cities and towns. Our interstate pipeline affiliate, Michigan Wisconsin Pipe Line Company, transports gas from the Louisiana Gulf Coast, from the Panhandle-Hugoton area of Texas and Oklahoma, and from Canada for sale at wholesale to Michigan Consolidated and 53 other gas distribution companies located in Michigan, Wisconsin and five other midwestern states. Altogether we are the supplier of gas to an area having a population of over 8,000,000.

We propose to build in western North Dakota a coal gas plant using lignite as feedstock and producing about 91 billion cubic feet of high-Btu gas each year. This is enough gas to heat about 450,000 homes in our service area and would constitute about 10 percent of our present system supply. We propose to build the plant in two phases, the first to be completed in 1981 and the second several years thereafter.

If H.R. 12112 is enacted and if we are awarded a loan guarantee, we would be able, we think, to begin construction sometime next year.

We are confident of our technology.

We have secured the necessary state permits to draw water from the Garrison Reservoir on the Missouri River.

We have made our filing with the Federal Power Commission and have completed hearings on all but the environmental aspects of our case by the end of next week.

We have filed an extensive Environmental Impact Report, and a draft EIS is now being prepared by the Department of the Interior.

The fact of the matter is, however, that while we think we can finance our project with the loan guarantees contemplated by H.R. 12112, we know that we cannot finance without them.

The central problem in financing without Government support is simply one of size. My company's net plant investment is about \$1.8 billion, which makes us one of the larger gas utility systems in the country but a relatively small company as compared with the major oil and manufacturing companies. The difficulty is that a

single 250 million cubic foot per day coal gasification plant is estimated to cost about \$1.5 billion by the time it is completed in the early 1980's, or roughly the equivalent of the entire investment my company has accumulated in the 75 years since it was formed.

Even if American Natural guaranteed the debt to be issued by our coal gasification project, therefore, our System's assets and income simply do not provide the credit base sufficient to convince lenders that American Natural could pay off the loan if the project went under. And we could not prudently agree to such a guarantee in any event because to do so would seriously affect our ability to raise capital for other gas supply projects and to maintain the safety and reliability of our natural gas system.

The question is frequently asked why, if the project is economically and technologically viable, investors are not willing to put up the necessary capital without Government guarantees. The answer is that our System and other sponsors of coal gasification projects are willing to risk the equity capital required by the project, amounting to 25 percent of its total cost. The problem is that the other 75 percent must be provided by lenders who are unwilling to take the same kinds of risks and demand assurances of a return of their capital. With an investment this size and a new technology involved, these institutional lenders, who are fiduciaries, simply cannot take the risks that are involved.

The nation's supplies of natural gas are dwindling rapidly, and our System urgently needs the deliveries from the first coal gasification plant to meet essential customer requirements in the

early 1980's. Beyond that, we must establish as quickly as possible the technological and financial viability of these coal conversion processes so that many more plants can be constructed in the remaining years of this century.

It is for these reasons, essentially, that our company hopes that Congress will, as swiftly as possible, enact a loan guarantee program that will enable firms of moderate size to continue participating in the development of high-Btu coal gasification projects.

I would like to turn now to some of the questions that have been raised about the loan guarantee program insofar as high-Btu coal gasification projects are concerned.

First, the question is raised whether the deregulation of natural gas, or a substantial increase in wellhead prices, would not obviate the need for gas produced from coal. The answer to that is clearly "No."

While there are undoubtedly significant quantities of potential reserves of natural gas yet to be discovered, and while deregulation would clearly increase the incentives to drill for natural gas, we see no possibility that the rate of new reserve additions would rise sufficiently to offset the decline in existing gas reserves. Accordingly, we foresee a continually widening gap between natural gas supply and demand even assuming considerably higher natural gas prices and the reduction of market demand to high priority uses.

In this connection let me briefly make three points:

(1) From peak discoveries of new reserves totaling about 21 trillion cubic feet per year in the years 1964-67, new reserve

additions in the lower 48 states have fallen to an average of only about 9 trillion cubic feet in each of the last five years. Production of gas is at a level of about 20 trillion cubic feet annually, leaving a supply gap of about 11 or 12 trillion cubic feet per year. While deregulation would certainly help to narrow this gap, the need for supplemental supplies is clear and unmistakable.

(2) Whatever the estimated potential of undiscovered reserves, it will take a long time to discover and produce them. The largest pools and those easiest to find and produce have long since been discovered. What is left are the smaller reserves, the deeper reserves, the reserves located under the ocean beds and those located in remote and inhospitable Arctic regions. So, while the potential reserves of natural gas may be there, it will be increasingly difficult, costly and time-consuming to find, produce and transport them to market.

(3) While the initial price of gas produced from coal will be higher than domestic natural gas, coal gas has several distinct advantages over the long term. First, its cost will remain virtually constant over the 25-year life of the gasification plant and may even decline, whereas the cost of natural gas and every other alternate fuel will continue to increase at at least the rate of general inflation. Thus the cost of coal gas will undoubtedly be a bargain before the plant is half depreciated. Second, a new natural gas reserve delivers full volumes for only 5 to 10 years, after which deliveries from that reserve decline and are exhausted in 15 to 20 years. A coal gasification plant will operate at full capacity

for the entire life of the plant of 25 or 30 years or longer, and we have ample coal reserves for that period.

I should add that our System does not contemplate that we will be serving any low priority boiler fuel loads with gas produced from coal and that this supplemental supply will be required to meet residential and small commercial market requirements.

Assuming that the cost of synthetic gas made from coal is rolled-in, or averaged, with the larger deliveries of natural gas on our System, the overall cost of gas to the consumer will not be increased inordinately and will remain below the cost of fuel oil and far under the cost of electricity for an equivalent number of Btu's.

The question is sometimes asked whether the need for loan guarantees does not necessarily imply that the projects are uneconomic and whether the loan guarantee program is not in essence a subsidization of the private utility business. The answer to both questions is "No."

The coal gasification project we have proposed is economically feasible and will provide a return on capital to both debt and equity investors. As I have stated, the market for the product will clearly be there, and the rolled-in price of synthetic and natural gas can be sold competitively with other fuels. The equity investor--our company--is willing to risk its investment. The difficulty is that the lender--the institutional investors who must supply the debt capital--cannot afford to risk the large sums of money involved on a brand new enterprise never before tried in this county. That does not mean that the lender does not believe that the project is technologically and economically viable. It

simply means that until enough plants have actually been built to demonstrate their viability, the lenders, as fiduciaries, cannot afford to provide the very large sums required.

The loan guarantee program in no sense provides a subsidy to the sponsoring utility system. In the first place, the guarantee only protects the lender, not the equity investor, whose investment is completely at risk if the plant is not successful. Second, no front end money is involved; the loan guarantee comes into play only in the unlikely event the plant is not completed or is otherwise unable to produce enough gas even to pay the debt service. Third, any reduction in debt costs resulting from the Government loan guarantee would simply lower the cost of gas to the consumer, not increase the owner's profit. The utility's earnings from the plant will be set by the Federal Power Commission at a fixed percentage return on the equity actually invested in the plant.

Another question sometimes asked is whether it would not be advisable to construct low-Btu coal gasification plants at lower cost.

It should be understood that low-Btu gas cannot be mixed with natural gas and therefore could not be transported or distributed in existing gas pipeline and distribution systems or consumed in homes and commercial establishments. Its only use is as an industrial fuel. For that reason, a low-Btu gasification plant would not meet the need for large supplemental supplies of gas to meet residential and commercial needs.

While low-Btu gas may be used to meet industrial energy needs, that is possible only where a large industrial complex can

be supplied by a separate distribution system. Even then, problems of utilization, standby systems, etc. must be overcome.

It should be recognized, moreover, that unlike a high-Btu coal gasification plant built at or adjacent to a mine, a low-Btu plant must be built very close to the user industrial complex both because of the high cost of transporting the gas long distances and the high carbon monoxide content of low-Btu gas. This means that the coal must be transported from the mine to the plant by rail or water at a much higher cost per Btu than the transportation of high-Btu gas through a pipeline. Thus, a lower cost of producing low-Btu gas could be offset by a higher cost of transporting coal to the plant.

We believe that there may be a role for low-Btu coal gasification plants in certain specific market areas, but it in no way lessens the more immediate need for coal gasification plants that can provide gas which can be mixed with natural gas for distribution to homes, stores and apartments through existing distribution facilities.

Finally, the question has been raised as to whether, if the need for loan guarantees arises because the investment required is so large in relation to the size of gas utility systems, some other segment of industry might be better equipped to undertake these projects.

I think it is significant that all of the high-Btu coal gasification projects now proposed are sponsored by gas pipeline and distribution systems. We are trying to implement these projects, not because of the financial rewards, but because of our responsibility to provide gas to the market areas we serve. In short,

it is not the kind of project a company undertakes based merely on an evaluation of the economic risks and rewards.

We doubt seriously, therefore, that any other segment of industry would be interested in sponsoring projects of this kind. For one thing, since the gas will be mixed and distributed with regulated natural gas, the price of the gas will necessarily be a regulated one. It is highly unlikely that any unregulated segment of industry would be willing to undertake projects of this kind with a regulated rate of return, and none have done so.

Furthermore, the necessary implication of the question is that, if companies our size cannot finance these projects without Government support, companies having much larger financial resources should do the job. This would mean, as a practical matter, that the development of synthetic fuels from coal would be taken over by the major oil companies, if by anyone.

In summary, the people who have gone forward with coal gasification projects are the gas transportation and utility systems (1) who are willing to operate in a regulatory environment and under a fixed rate of return, and (2) who have a service obligation to particular customers and market areas. However, these companies simply cannot raise the debt capital required for the first few plants without Government support.

We respectfully request that the loan guarantee program be enacted so that we can go forward promptly with development of this urgently needed source of energy.

ARTHUR R. SEDER, JR.

Born: April 20, 1920

Attended Elementary School in St. Paul and University High School in Minneapolis, Minnesota. Attended University of Minnesota and Northwestern University 1938 - 1941.

Enlisted in U.S. Army Air Corps October 1941; Commissioned Second Lieutenant U.S. Army Air Corps, January 30, 1942. Served as navigation instructor and Director of Ground School, U.S. Army Base, Carlsbad, New Mexico. Assistant Group Operation Officer, 401st Bomb Group, 8th Air Force in England; flew 25 missions as pilot or air commander of heavy bomb group. Returned to inactive duty with rank of Major.

Attended Northwestern Law School 1945 - 48; graduated magna cum laude and was Editor in Chief of Northwestern University Law Review (then known as Illinois Law Review); member of the Order of the Coif.

Admitted to practice of law in State of Illinois, 1948. Law Clerk to Chief Justice Fred M. Vinson, U.S. Supreme Court, 1948 - 50.

Joined Chicago law firm of Sidley, Austin, Burgess & Smith (now Sidley & Austin) in June 1950 and became a partner in 1956. Resigned December 31, 1972. General Counsel, American Natural Gas Company 1967 - 1972.

Elected President and Chief Administrative Officer of American Natural Gas Company and subsidiaries January 1, 1973.

Statement of J. E. Bixby
Vice President and Chief Financial Officer
Texas Eastern Transmission Corporation, Houston, Texas

Before the Subcommittee on Energy and Power
of the Committee on Interstate and Foreign Commerce
United States House of Representatives
May 26, 1976

Thank you for the opportunity to appear before your committee as it considers H. R. 12112, providing additional assistance to the Energy Research and Development Administration for the advancement of non-nuclear energy research, development, and demonstration. I appear in strong support of the objectives of this bill, particularly with respect to high-Btu coal gasification.

Texas Eastern Transmission Corporation is engaged in several phases of the energy business, but its largest segment is the operation of two interstate gas pipelines regulated by the Federal Power Commission. In this role it serves the Midwest, Mid-Atlantic and New England sections of the country through its Eastern System, and the Midwest and Southern California areas through the Western System, operated by a subsidiary, Transwestern Pipeline Company. Both systems have suffered from serious shortages of gas supply and have found it necessary to curtail deliveries to customers for the past several years. Because we anticipated the shortage of traditional supplies, we have for many years been working on every alternative source of supply that appeared to offer any real promise of supplementing our natural gas sources. We have long been convinced that high-Btu coal gasification was a virtual necessity, and we have therefore committed much time, effort and money to pursuing this alternative.

It should be beyond any question that the nation has an endemic energy problem, notwithstanding the fact that there is no clear-cut "crisis" at the moment.

It should be equally clear that policies and practices which have helped create the problem do not offer hope of curing it. The problem is enormously complex, but the fact that solutions are difficult and unpalatable does not justify prolonged failure to act, particularly when such a failure could endanger the future security and economic well-being of the nation. It is my view that there is no single solution to our energy problem. Among the appropriate answers should be the deregulation of new natural gas supplies and the decontrol of oil prices, a step-up in energy conservation efforts and improvements in energy use efficiencies, and a number of other moves to improve the supply-demand ratio of our present energy sources without ever-growing and dangerous reliance on imports. At the same time, we must also intensify our efforts to develop alternate sources, such as synthetic fuels, which will enable us to make sure that our national future is not compromised.

H. R. 12112 is a start, and in my judgment, the start is already long overdue. In making the decision to start, however, we are not making an irrevocable decision to travel a particular path indefinitely. The program is, after all, a demonstration program, and as such will provide much valuable information as to the kinds and quantities of synthetic fuels which should be developed in the future. The route represented by H. R. 12112 should not be viewed as a freeway without off-ramps. Further, H. R. 12112 should not be considered as an "either/or" choice to some other "solution" to our energy supply problem. It is my view that it will be almost impossible for us to do too much in providing for a reasonably secure energy supply, and I can't imagine that we will provide too much energy for the needs of a sound economy. If that is the result, however, the extra cost can easily be justified as insurance against the risk of national catastrophe.

Among the various synthetic fuels on which research, development, and demonstration work is being done, high-Btu coal gasification is somewhat unique.

First, it involves the utilization of the nation's most abundant hydrocarbon resource - coal. Second, there is an established technology (the Lurgi process) by which a pipeline quality gas can be produced. Third, the product of a demonstration facility can be immediately used to alleviate a serious shortage of natural gas which is well on its way to becoming critical, and the facility could simultaneously serve as a testing ground for technological improvements. Fourth, the proposals for high-Btu coal gas facilities of which I am aware have all been sponsored by regulated utilities, so that there should be no concern about any "excess" profits from such projects.

The project with which my company is associated is noteworthy in at least two respects. One, it is the most advanced high-Btu coal gasification project in the country, and, two, the major portion of its output would be directed to an area of the country which has one of the most critical needs for supplemental gas supply, namely Southern California. The project is a co-venture between units of Trans-western Pipeline Company and of Pacific Lighting Corporation of Los Angeles. The plant would be located on the Navajo Indian reservation southwest of Farmington, New Mexico, and would produce 250 million cubic feet a day of pipeline quality gas from coal deposits located on the reservation which would be developed by Utah International. The project is known as Western Gasification Company, or WESCO. It represents an investment, exclusive of mine development costs, which in January 1, 1975 dollars was estimated at \$853,000,000, and which in completed-cost dollars will run well in excess of one billion dollars. If it could be assumed that construction could start this year, plant start-up operations could begin during 1980. It is now clear that construction cannot begin this year, but the timetable is of great importance, since Pacific Lighting has testified on the public record that they expect to have an inadequate supply to serve all of Southern California's highest

priority demand (the residential and small commercial customers) as early as 1978 or 1979. A report by the Staff of the California Public Utilities Commission released in February, 1976 indicates curtailment of high priority service throughout the state would begin in the early '80's, in the absence of deliveries from supplemental sources. The supply represented by the WESCO project appears to be the earliest significant addition in sight for the Southern California market, which would receive about three-fourths of WESCO's output.

In addition to alleviating otherwise certain delivery curtailments, the WESCO project and related mining operation offers substantial benefits to the Navajo Nation, one of the most economically depressed parts of the country. Job opportunities will peak near 4,000 during the construction period and operations will require about 1,000 employees. Preferential hiring policies and technical training programs are provided to maximize employment of Navajos. The project will also represent in excess of \$6,000,000 annually during operations for the Nation through payments for royalty and resources utilization. Further, socio-economic and environmental concerns have been and will continue to be fully recognized in the construction and operating phases of the project.

The original application to the Federal Power Commission for the WESCO project was filed over three years ago. Conditions are contained in the FPC amended certificate recently issued, but at least we have a basis for determining what else is necessary to make the project financially viable and even an unconditioned certificate would not have permitted financing. Environmental requirements are largely met and plant site lease negotiations with the Navajo Nation are at a very advanced stage. All in all, WESCO has just about everything ready to go - except financing. The ability to finance such a project is obviously critical, and the kind of assistance contemplated by H. R. 12112, in my opinion, is absolutely

necessary if we are to go forward with commitments of the magnitude required for such a project.

Before discussing the need for financial assistance for coal gasification, perhaps we should ask the questions "Why gasify coal? Particularly, why not wait until the newer gasification technologies are ready? Why not use coal in another form?" In addition to the earlier point that coal is the country's most abundant hydrocarbon resource, these answers are relevant:

1. Gasification is the most environmentally acceptable method of using coal and the most efficient use of energy values and of capital.
2. Availability of high-Btu coal gas will permit consumers to better utilize the billions and billions of dollars now invested in gas appliances, distribution systems and transmission facilities.
3. New gasification technologies will provide only limited potential cost savings since they will affect only a portion of the required facilities; meanwhile, by waiting, inflationary pressures on total costs would probably more than offset the savings.
4. As compared to use in new electric generating plants, coal in gasified form is a conservation factor because it is about twice as efficient and uses much less water. Coal gas energy costs are estimated to be only about half the costs in the form of electricity.
5. The U. S. needs to establish its national readiness, willingness and ability to provide physically for its energy needs on a basis other than importing, even though the indicated price might not be the lowest on today's market.
6. It is quite probable that the first coal gasification plant that is built of a size to demonstrate economic and technical viability will produce the

lowest cost gas we will ever see and that the plant's initial production cost might be its highest cost.

The last two points deserve some amplification. Much of the reluctance to embark on a serious commitment to synthetic fuels seems to be the fact that the future cost of the synthetic is judged to be clearly excessive when compared to today's price for traditional forms of energy. Even though this compares apples and oranges to some degree, the major flaw in this approach is the failure to credit synthetics with an adequate "independence" value. Applied to coal gasification as illustrative of a currently viable alternative to vulnerable imports of energy, a risk/reward analysis would conclude that any "excess" cost really represented a quite reasonable national energy insurance premium. If it develops that other measures are indeed adequate to elicit large new supplies of traditional forms of energy or that our national security is never exposed to a repeat embargo, then we will have incurred the cost of a synthetic fuel capability needlessly. Even in such an unlikely case, this unnecessary cost would be a drop in the bucket as a part of our total energy bill. On the other hand, a failure to provide a timely synthetic capability which turned out to be needed might well lead to national disaster. In my judgment, such a trade-off is unthinkable. The implications for national security and for the total economy simply do not permit this kind of gamble.

The statement that the lowest cost gas would probably come from the first plant reflects the heavy fixed-cost component in high-Btu coal gas (about two-thirds of total cost). Even though we do not expect a return of the double-digit inflation which helped to skyrocket plant cost estimates, neither are we expecting inflation to disappear. Thus, the highly capital-intensive nature of coal gasification and the continuing rise in the required capital investment will tend to offset savings from

economies and technological improvements which might be available in later plants. The peaking of costs during initial production is possible because of Federal Power Commission regulatory practices and, again, because so much of the total gas cost is capital-related. The FPC will set rates for coal gas in interstate commerce on the same depreciated-original-cost type of rate base it has always used. As depreciation is experienced, the rate base declines and the return declines with it. This decline may well be enough to offset increases in more variable costs and almost certainly would result in the initial cost being higher than the average cost over the project life.

You may ask why, given all of the advantages and benefits of coal gasification I have listed, such a project cannot be financed without government assistance. Although the answers are somewhat more complicated, they may be summarized as follows:

1. The sheer magnitude of the capital cost and the extended construction period.
2. The lack of financial capacity of project sponsors to attract the necessary capital on their own and a particular inability to take the completion risk.

To illustrate these relationships, let us assume for arithmetic simplicity that the WESCO project will cost \$1.2 billion when completed and that the equity portion of capital will be the 25% required upon completion by the provisions of H. R. 12112. This equity would thus amount to \$300,000,000 of which Transwestern's half would be \$150,000,000. The problem becomes clearer when this amount is compared to Transwestern's total net worth of just over \$120,000,000 at December 31, 1975. The magnitude of the equity capital commitment should make it quite apparent that debt capital cannot be attracted by sponsor company credit capacity and that financial

backstopping of some kind by a financially credible party is absolutely essential.

The three to four years required to reach initial operations of a gasification plant intensifies the completion risk significantly and further precludes sponsor financing as such. It has been suggested that if appropriate regulatory actions were taken to assure investors that the total costs would ultimately be paid for by consumers, capital would be forthcoming to finance such projects without involving the government at all. Such views may be more wishful thinking than realistic analysis, because the existence of regulation is simply not an adequate base on which to finance on a true "project basis" capital requirements of the magnitude involved. On the contrary, investors are well aware that the Federal Power Commission, for example, cannot bind its successors on future rate treatment and they are wary of the rules being changed while the game is still in progress.

The completion risk is a serious concern for project sponsors because it is a serious concern for investors. In addition to regulatory worries about rates, investors worry about lawsuits, or legislation or technological problems preventing completion of the plant or its uninterrupted operation at design levels. We are confident of our technology, of course, but it does represent a scale-up that has not yet been demonstrated to the satisfaction of investors. We do not think these fears will be realized, but investors need and demand assurance and we are not financially able to give it to them.

H. R. 12112 contains provisions which we think may well permit financing of high-Btu coal gasification facilities and we therefore strongly support it and urge its passage. There may be imperfections in the bill and there are certainly different ways to accomplish a given purpose, but there is an urgency in at least getting started that I hope the members of the Committee can appreciate and can convey to their colleagues.

The loan guarantee approach contained in H. R. 12112 is an appropriate one for a high-Btu coal gasification project, and in my opinion the government will never spend a single dollar making good on that guarantee. The availability of loan guarantees up to 90% of total costs during construction and start-up is an especially important provision in reducing the completion risk to hopefully acceptable levels so that the ultimate purpose of building projects is actually accomplished. It is worth re-emphasizing that the regulated utilities sponsoring high-Btu coal gasification projects are able to accept limited risks only, because regulation precludes their ability to earn rewards commensurate with greater risks.

In conclusion, I urge your favorable consideration of an impetus to synthetic fuels as represented by H. R. 12112. We very much need to get a start and we cannot wait for another study or a new analysis to measure every change in circumstances or we will never begin. Coal gasification can be accomplished now on a basis completely consistent with the objectives of the National Environmental Policy Act, with state and other local environmental and development standards, and with Navajo Nation objectives. I freely confess bias, but I think our WESCO high-Btu coal gasification project in many ways could be one of the most significant accomplishments available in helping to solve our long-term energy problems. Such projects must inevitably be built and continued delay only assures higher costs to consumers. We need your help in getting under way and I hope we will have it very soon.

Thank you again for the opportunity to express our views on this very important matter.

J. E. Bixby
Vice President and Chief Financial Officer
Texas Eastern Transmission Corporation

J. E. Bixby is Vice President and Chief Financial Officer of Texas Eastern Transmission Corporation and of its subsidiaries and is a member of various company management committees. He is directly responsible for the comptroller's, treasurer's and corporate secretary's functions.

A native of Houston, Mr. Bixby joined Texas Eastern as Assistant Treasurer in 1956, was promoted to Treasurer in 1957 and was named a Vice President in 1963. He was made Vice President and Comptroller in 1965 and assumed his present duties in 1967. Prior to joining Texas Eastern, Mr. Bixby was employed by State National Bank of Texarkana, Arkansas, Hughes Tool Company (interrupted by service in the Merchant Marine) and W. S. Bellows Construction Corp. of Houston.

Mr. Bixby is a graduate of the University of Houston and holds Certified Public Accountant certificates in Texas and Louisiana. He is a member of the national, state and local professional accounting organizations, of Financial Executives Institute and of various industry organizations. Included in his industry service was a term as chairman of the Gas Industry Finance Committee of American Gas Association. Outside his company, he serves as a director of Southern National Bank of Houston and of Medenco, Inc. He is also a member of the Financial Analysts Federation and a past president of the Houston Society of Financial Analysts.

STATEMENT SUBMITTED TO
SUBCOMMITTEE ON ENERGY AND POWER
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, D.C.

Robert McClements, Jr.
President, Sunoco Energy Development Company
Dallas, Texas

May 26, 1976

Good afternoon.

I am Robert McClements, president of Sunoco Energy Development Company of Dallas, Texas, a wholly-owned subsidiary of Sun Company, Inc., of St. Davids, Pa.

We are pleased to have this opportunity to share with you our views on the outlook for producing synthetic fuel from oil shale. I will do this by speaking directly to the three questions that were posed, namely these:

- (1) Is it economically feasible to produce synthetic fuels from oil shale?
- (2) What would be the environmental consequences of producing synthetic fuels from shale?
- (3) Is government assistance necessary for the production of synthetic fuels from shale?

I will preface my response to these questions by pointing out that Sun is a participant in the White River Shale Oil Project, which was formed to develop the "Ua" and "Ub" federal oil shale leases in the Uintah Basin in Utah. Sun's share of the cost of the successful bids for these tracts was \$52 million. We have also spent some \$4.5 million for engineering and environmental work associated with oil shale development over the past two years.

We have no proprietary process position in oil shale, and our interest is based solely on its potential for becoming a viable business able to stand on its own feet in the marketplace.

Now, looking at the first of the three questions, is it economically feasible to produce synthetic fuels from oil shale?

In the present situation, our answer to this question must be no. It simply is not possible today to design, construct and operate an oil shale facility to produce synthetic fuel that could compete with conventional petroleum at current world oil prices.

This fact was demonstrated clearly in a comprehensive study recently completed by one of the nation's largest and most experienced engineering firms. This study indicated that synthetic oil would have to sell for more than \$20 per barrel (in 1975 dollars) to yield a 15 per cent return on investment on a 100 per cent equity investment basis.

A second difficulty is the huge amount of capital required for constructing synthetic fuel facilities. For example, it is now estimated that the capital required for a 100,000 barrels daily plant would exceed \$1.5 billion (again, in 1975 dollars).

Further, we anticipate that synthetic fuel from shale will be even less competitive in the future. Realistically, we must expect that price escalation for synthetic oil produced by a capital-intensive and labor-intensive oil shale plant will be greater than escalation in the world price for conventional oil.

Those, briefly, are our thoughts on the question of the economic feasibility of producing synthetic oil from shale. And I should add that even this outlook is based upon very optimistic assumptions about the future. We have some concerns that could make the shale oil outlook even less promising, and I want to share these with you.

First, we feel that the present level of technology development is unsatisfactory for proceeding into a commercialization program. Up to the present time, the technology associated with oil shale retorting

has been demonstrated only at the pilot plant or semi-works level. The scale-up to new commercial-size units carries an extremely high level of technical risk.

Second, a commercial-size oil shale facility will require the close integration of a series of large, complex operations involving new technology. Each section of the total complex must operate with a high degree of reliability to maintain desired production levels. The probability of obtaining the necessary degree of reliability is jeopardized by the certainty that continuing process and equipment development will be required.

Third, the magnitude of the investment in a shale oil plant and the required long life of the facility demand stability in the political and regulatory outlook. Today, however, the public policy climate is highly uncertain. And continuing uncertainty about the future course of public policy could prove to be a serious impediment to synthetic fuels development.

Finally, timing uncertainties pose further difficulties. Very long lead times are involved in the development of synthetic fuel facilities under the best of conditions, and these considerations are further complicated by delays in approvals, environmental reviews and continuing litigation.

Now, moving on to the second question, what would be the environmental consequences of producing synthetic fuel from oil shale?

Oil shale facilities will without question impact their local environments in a number of ways. Substantial amounts of time and money have already been spent in studying and defining these impacts, and in preparing to deal with the problems that will be faced. And many millions of dollars will be required in the future to prevent or mitigate environmental pollution.

A variety of environmental facilities and programs will be necessary. These will include complex and costly facilities for air, water and solid waste control. They will include programs for the rehabilitation, preservation and management of environmental resources, including the revegetation of disturbed lands, the management of fish and wildlife resources and the protection of objects of historic and scientific interest. And still other programs will be necessary for the prevention and control of fire, accidental spills and other hazards to public health and safety.

During all project operating stages, it is planned that plant units will be operated within the limits of the Federal New Source Performance Standards for air pollution control. All sources of project-generated emissions will be identified, and facilities will be provided to insure compliance with regulations governing air quality.

Solid wastes will be disposed of in sanitary landfills which will be planned and operated to minimize erosion. All disturbed surfaces will be revegetated. And saline or toxic drainage will be prevented from contacting ground and surface water resources.

Processed shale will be disposed of in canyons or other surface depressions. These disposal systems will be designed in such a way that all surface and sub-surface runoff from the processed shale will be intercepted and prevented from entering any natural drainage courses.

A detailed plan was recently completed for the environmental control of the oil shale project that our company is associated with. This plan outlines predicted environmental impacts from the construction and operation of the facility, and includes the proposed procedures for eliminating or mitigating potential resource pollution. We would be happy to make this detailed study and plan available to any interested party.

I want to stress that the major concern of the design engineer in the environmental area is the uncertainty of standards or regulations that he must use as design criteria. In this respect, the enactment of the new source emission standards -- the so-called "no significant deterioration" standards -- now being debated in Congress could preclude the development of our country's oil shale resources.

Turning now to the third question, is governmental assistance necessary for the production of synthetic fuel from oil shale?

On the basis of the economic realities that I described earlier, we believe that government assistance is necessary in developing the nation's oil shale resources. This view reflects our conviction that at the present time synthetic fuel from oil shale cannot be produced to compete in the market with conventionally-produced oil. The required investment of more than one billion dollars, coupled with the existing technical, environmental and political uncertainties, preclude the possibility of a significant oil shale industry emerging solely from the private sector.

At the same time, we are convinced that oil shale development is essential to strengthening the longer term energy position of the nation, and that the orderly development of an oil shale industry must have high priority in our overall national energy picture. The enormity of the resource alone singles it out as one of the strongest contenders for the role of a major alternative source of liquid hydrocarbons to supplement our declining oil reserves.

Accordingly, we feel it is essential that a program be designed to make possible joint public-private development of the nation's vast oil shale resources.

As a first priority, such a program should provide for the demonstration of a variety of competing infant technologies. In other words, rather than initially building very large plants, we suggest the emphasis be placed on constructing a number of smaller modules with equipment that could be utilized in commercial operations. Such modules would not only make possible the demonstration and evaluation of alternative technologies, but would also provide a basis for predicting capital, operational and environmental costs.

Initially, each module would consist of a minimum number of units. But each would be designed so as to make possible the construction of additional units if the program was judged to be successful.

We anticipate that the cost of each module would be in the \$100-\$200 million range. This level of costs, upon which no return could be expected, clearly indicates the need for joint industry-government funding through the stage of technology demonstration. If a module successfully demonstrated a new technology, and if economic conditions permitted, then the government's interest could be acquired by the industry partner under previously agreed-upon terms. In this way, the facility could become the core of a truly commercial venture.

Before closing, I want to inform you that I previously testified in more detail on these matters before the House Committee on Science and Technology. Rather than repeat all of the material here, I am including a copy of that testimony with this statement for the information of the Committee.

In conclusion, let me reiterate these points. In the light of large capital requirements and the technological and environmental

difficulties that must be overcome, we feel that synthetic fuel produced from shale could not compete in the market with conventional oil today. Accordingly, we feel that some degree of government assistance in shale oil development is required. And we have recommended a relatively short-term program of industry-government cooperation to advance this development effort through the technology demonstration phase.

Beyond this, we suggest to you that the longer-term viability of a shale oil industry will depend largely on the nature of our national public policies on energy.

Thank you.

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Statement by Hollis M. Dole
Atlantic Richfield Company

to the

House Committee on Interstate and Foreign Commerce
Hearings on HR 12112

Washington, D. C.
May 26, 1976

I am Hollis Dole, Washington Representative for Atlantic Richfield Company.

Prior to my accepting this responsibility in April, I was General Manager of a four-company venture, Colony Development Operation, which is actively engaged in oil shale research and development activities and has been for several years. Atlantic Richfield serves as operator for the group which includes Ashland Oil, Inc., Shell Oil Company and The Oil Shale Corporation (TOSCO).

I am here today to express Atlantic Richfield Company's views on the immediate need for a joint industry-government synthetic fuels commercial development program and the role government incentives can play in fostering the early construction of synthetic fuel projects.

Knowledgeable forecasters in the energy field predict a widening gap between expected domestic energy demand and domestic supply for the foreseeable future and at least to the end of the century. A harbinger of this occurred during the second week in March when oil imports exceeded domestic oil production. As this Nation struggles with its energy problems, it should be obvious that a prime objective of a policy should be to improve our energy self-reliance.

In Atlantic Richfield's opinion, a sufficiency of domestic energy production will come to fruition only if this Nation actively pursues the several options available to us--increased exploration for oil and gas both onshore and offshore, accelerated utilization of coal and nuclear energy sources, development of synthetic fuels, and greater research in the development of energy sources such

as solar, wind, fusion and the like.

Another prime objective is a vigorous national energy conservation program. Conservation is the only option that can have immediate results but like all of our options, it is only part of the solution to the country's energy problem. We are fortunate to have several options but it is an imperative to our national strength that we vigorously pursue all. A strategy that does not take full advantage of all options will likely result in a decrease in U.S. energy self-sufficiency and a subsequent increase in oil imports. With this brief mention of the Nation's energy situation I would like now to focus my remarks on the stimulus I feel would initiate shale oil production--a potentially significant domestic energy supply source.

Although the technology is well advanced, commercial shale oil plants have not been built in the U.S. because of the past availability of cheap conventional oil, both domestic and foreign, recent unprecedented inflation in the construction industry and present artificially depressed energy prices resulting from government controlled oil and gas prices. There is no question in my mind that if the first few commercial synthetic fuel plants are to be constructed in the near future government incentives must be established. Federal aid is in the public good because of the huge size of the oil shale resource and the need to move definitively to understand on a commercial basis the technology, the economics, the environmental and social impacts of synthetic production.

In October of 1974, Colony Development Operation suspended its plan for a mid-1975 construction start of a 50,000 barrel per day commercial oil shale complex on private lands in northwestern Colorado. A key reason for the suspension was the debilitating increase in construction cost during the year. A 50,000 barrel per day oil shale complex is now estimated to cost in excess of one billion dollars, when development expenditures and reserve values are included in the total estimate, and is more than three times the cost estimate of 1973.

Even though oil shale economics are discouraging, we believe that oil shale holds as much or more potential than other synthetic fuels. Based on our analyses of relative costs of hydrocarbon production, finding new conventional oil and gas remains less expensive than synthetic fuels but the cost of shale oil is less expensive than the conversion of coal to oil or gas. I do not have to tell this Committee that there is an urgent need not only to develop additional conventional oil and gas but also to develop and demonstrate at commercial-scale the production of oil and gas from coal and oil shale.

It is an established principle in our country to provide incentives to foster the growth of new industries or to maintain the viability of existing industries that are in the national interest. These incentives have taken numerous forms--but clearly the most effective have been ones which tend to ameliorate risks so that the investment motive would still function.

Atlantic Richfield is convinced that a few early oil shale projects should be candidates for joint industry-government funding in order to evaluate the impacts of oil shale development. We submit that the broad program objective would be to define the potential of oil shale through private enterprise and government risk-sharing in order that shale's role in future energy supply would be more precisely known. This, we feel, would allow Congress and the Administration to provide better energy planning for the people of the United States.

As an example of a possible useful approach, we find constructive the incentives concept embodied in last year's lead synthetics fuels bill S-598.

A seventy-five percent non-recourse loan, backed by the government, coupled with a permanent extension of the investment tax credit at a rate of at least 10% for synthetic fuel plants, could provide the financing mechanism necessary for the construction of the first few commercial oil shale plants to demonstrate available technologies. Quite clearly, the greater the amount of the investment tax credit rate, the more favorable the economic impact

would be on the project with a corresponding reduction in the amount of government assistance in the form of loans. A joint industry-government synthetic fuels program should not imply nor suggest that continued government participation will be expected by industry after these first few plants are in operation. If the economics and the impacts prove to be as favorable as we expect they will be, a climate conducive to the attraction of long-term financing will be established. This, of course, assumes free market conditions in the energy sector and rational processes allowing environmental decisions to be made in a reasonable time frame.

Atlantic Richfield supports the concept Congress is considering in H.R. 12112. However, the restriction of the loan guarantee in Section 18(b)(1) that "...no loan guarantee for a full-sized oil shale facility shall be provided under this section until after successful demonstration of a modular facility..." should be eliminated and we strongly urge revision of Section (5)(A) of the bill to include both single full-sized retorts and multiple retort commercial plants. Selection between these alternatives should be the free choice of industry and a reflection of the specific next step requirements of the developer and his confidence in the state of the retort technology to be employed in the project.

In Colony, Atlantic Richfield has carefully weighed a host of factors and believes, for several reasons, that the next logical step is the construction and operation of a commercial size shale oil plant. A single, full-sized retort cannot take

advantage of economies-of-scale that are possible in a commercial plant and cannot be built materially faster than a commercial plant. Obviously, more can be gained by learning from a commercial size plant than can be learned by extrapolating from a module. I even question the exercise of extrapolation. It is answers we need, not more estimates.

The benefits to be derived from a commercial synthetic fuels program for early oil shale projects are substantial in terms of national energy policy and resource development. However, it must also be understood that the lead times associated with full-scale commercial oil shale development are long. It takes six to nine years to acquire and evaluate reserves, complete the environmental impact statement process, perform engineering design, obtain necessary permits and construct a commercial oil shale plant. Opting to develop a single train retort first will add up to five more years to the lead time associated with a commercial plant. The magnitude of shale oil reserves (several hundred billion barrels) justifies a near-term commercial scale construction program so that the nation can move more quickly and confidently toward appreciable production from oil shale.

Mr. Chairman, this concludes my formal presentation as it applies to H.R. 12112. However, in any discussion on the development of oil shale, I believe it is absolutely essential that the environmental and socioeconomic impacts be addressed. Actually, Colony was studying these impacts before the National Environmental Policy Act

became law. We have spent over \$3 million in these studies and have turned out an environmental impact analysis of 3 volumes with 17 appendices by over 100 consultants. A draft environmental impact statement has been prepared and subjected to public review. Presently the final EIS is being put into final form and is expected to be issued this year.

I have incorporated in my written testimony a short description of this work.

I would be pleased to read it into the record at this time. However, if, in the interest of time, the Chairman would prefer that I not take the time of the Committee and would give me the assurance that it would be included in the record, this will complete my oral statement. On the other hand, if you would prefer, I will continue and read it into the record.

Any industrial development which creates population growth causes some socioeconomic impact whether this growth occurs in urban or rural environments.

The construction of two or three commercial shale oil plants over the next five to eight years in the Piceance Basin will have no more impact socioeconomically on the Western Slope region than would expansion of the skiing industry or the construction of one major consumer goods manufacturing facility. An analysis of the employment trends in the Mesa, Garfield and Rio Blanco tri-county area of Colorado over the past decade shows that unless industrial or tourist related complexes of some magnitude are built soon, the Western Slope region will suffer the socioeconomic problems inherent to any economically depressed region.

As a venture which is dependent upon having a supply of dedicated, skilled and experienced employees available to build its plant and staff it over the long term, Colony Development Operation has long recognized both the potential problems and its responsibility to the community in which its plant is to be located. We have conducted extensive studies and plan to create a new community near the proposed plant site to avoid adverse impact on the nearby communities and the creation of numerous temporary settlements scattered along the Colorado River. We appreciate the socioeconomic implications of our proposed endeavor and believe the local community agrees with us that the potential impacts of our development are manageable.

The environmental aspects of oil shale development have received intensive attention and publicity over the past several years. Environmental demonstration programs have been conducted as well as numerous in-depth studies in the areas of air quality, water quality and ecology. Consequently, we have high confidence in our ability to design and construct environmentally acceptable facilities.

I would like to point out that this could be the first major new industry to be started after the passage of the National Environmental Policy Act, the Clean Air Act, and the Federal Water Pollution Control Act Amendments of 1972 and therefore subject to the rigors of examination and compliance of these laws right from the beginning. It will not only be conforming to the laws that Congress has passed, but also to the desires of the people that the environmental consequences

of industrial development be minimized. The activities of private industry have been such that oil shale will be developed environmentally right the first time and will not have to undergo the expensive retrofitting that other industries find themselves facing today.

Testimony of
EDWIN M. WHEELER
PRESIDENT
THE FERTILIZER INSTITUTE

BEFORE THE

SUBCOMMITTEE

ON

ENERGY AND POWER

OF THE

INTERSTATE AND FOREIGN COMMERCE COMMITTEE

U. S. HOUSE OF REPRESENTATIVES

H. R. 12112

May 26, 1976

The Fertilizer Institute
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Washington, D. C. 20036
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Mr. Chairman and Members of the Committee:

On behalf of The Fertilizer Institute we are pleased that we have been given an opportunity to make some observations on H.R. 12112 which relates to providing loan guarantees for commercial sized demonstrations of new and or improved energy technology.

By way of explanation, The Fertilizer Institute is the national trade association for the producers, manufacturers, miners, retailers, and brokers and traders -- our over 315 members cover the full spectrum. Included in our membership are virtually all of the major producers of nitrogenous fertilizer in this country.

It is generally accepted by all authorities that the use of commercial fertilizer in the United States enhances our food production not less than 30%. Were a person to confine his observations to the nearly 90 million acres of corn planted in the country then the results that would flow from the use of nitrogen would run well above this 30% figure. While I neither plan to make the Committee experts in the field of chemical engineering or agronomy it is necessary first to set the scenes so that the Committee will understand our tremendous concern over energy supplies.

All nitrogen in the United States is produced with natural gas used as a feedstock. It is true that any other hydrocarbon can be used as a feedstock but it so happens that all of U.S. technology is based on this resource. Overseas, except in the Mideast, the bulk of the anhydrous ammonia produced comes from either naptha or other petroleum-based products. It should be noted that the surge of new plants announced and under construction in the USSR and Peoples Republic of China are all natural gas feedstock plants. From ammonia comes products familiar to some of you known as urea and ammonia nitrate. Farmers can use the anhydrous ammonia in its natural state or these other products depending upon their own crops and particular circumstances. From the very beginning I hope the Committee will understand that without additional and continuing supplies of natural gas there is no way in which the country can feed a growing population or for that matter, a growing world population.

On the back of this statement is Chart I, entitled "U.S. Anhydrous Ammonia Capacity." I invite the Committee's attention to the fact that in the current calendar year of 1976 total ammonia production in the United States at the end of this year will be about 19 million tons. The hatch mark in the column for 1976 shows the figure 304 and this is an addition to capacity of 304,000 tons. The Committee can see that in 1977 the industry is going to bring on a tremendous new tonnage now estimated to be 3,340,000 tons. The farmers

used 75% of the anhydrous ammonia produced in the nation. The balance of it goes into various industrial products, the chief user of which is synthetic fibers. The basis for synthetic fiber production in the U. S., interestingly enough, is the same anhydrous ammonia that our farmers use. The leading producer of anhydrous ammonia in the United States is CF Industries, a farmer-owned cooperative, who are also members of our association.

Basically, anhydrous ammonia is produced by a very complex chemical process of extracting the hydrocarbon from the gas and combining it with a natural nitrogen found in the air (NH_3). A new ammonia plant is estimated to cost now at about \$80 million for a 1,500 ton a day unit. The investment of the industry either in being or soon to be on stream is tremendous and that whole investment is up for grabs if we fail to come up with sufficient natural gas. Our industry has the feeling much like a man driving across the desert at night and watching his gas gauge slowly go down while being unable to locate a filling station.

As you can see from Chart II, we have experienced a rather erratic but nevertheless slowly growing pattern of curtailment due to natural gas. We had estimated a much higher loss this current fiscal year but due to mild weather and the sharp cutback of other industries that are substantial natural gas users we lost but 250,000 tons of production. Many have questioned if there is a natural gas shortage; however, our industry has no doubt that there is. We think

people fail to realize that we were "blessed" with not only a mild winter and unfortunately had high users of natural gas curtailed due to the general economic softness in the country. It is foolish to plan for this to be other than a one time "happy" coincidence.

To indicate the magnitude of our use Chart III clearly shows the current and future forecasted uptake of gas. Again, using 1976 as the base year one can note that the ammonia industry alone will use 668 billion cubic feet just for ammonia production. When one compares this with the total national output of 22 trillion cubic feet one can see our concern for anything that affects gas supply. I would only point out to the Committee that the figures are steady for 1978-79-80 simply because there are no indicated plants announced for construction in that period of time but, in any event, it is clear that we will level out at well over 800 billion cubic feet per year for the foreseeable future. This use is for U. S. sited plants only.

Assuming, as we do, (1) that the prospects for additional gas supplies in its natural state are not to be greatly expanded and assume that (2) the homeowners and others will prefer the ease and cleanliness of this resource, we would like to point out that several rather dangerous things are at hand due to the nation's inability to get together on an energy policy. If we are not able to produce natural gas or

a synthetic product in the country then the nation is going to be forced to build new nitrogen plants in the most volatile areas of the world, politically speaking. All of us are familiar with the wasted and flared gas of the Mideast but it is my personal judgment over the long pull that it is too risky for the farmers of the United States and indeed the country's population to premise its food production on this area of the world. We have seen what an oil embargo, even over a short period of time can do to the country, but I would shudder to think in the 1980's if we were faced with a nitrogen embargo were plants to be built in that part of and were we to incur the displeasure of some Mideastern shiek. The risk is simply too great.

While we discuss the Mideast always the question comes up, "What about Canadian sources?" There are several plants to be built in Alberta but those plants are 51% owned or controlled by Canadians. In addition we have found that the Canadians have been just as active in moving up energy prices as have those in the Mideast and any of you who represent a state from among those tier of states along our northern border know how rapidly the price of Canadian natural gas has risen. In addition, we in the industry have been stunned by the Province of Saskatchewan announcing that they are going to take over all or part of the mines that produce another vital nutrient, potash, so that one can imagine how reluctant our industry is to consider any further development in Canada. So always it comes back to the need for answers that lie within the continental limits of the United States.

We have testified before the Senate and House several times and at length on the proposition that new natural gas discoveries should not have price control on that gas. We recognize that we could be paying a much higher price for the gas but if one has a plant valued at from \$50 to \$80 million sitting out in the country he does not particularly feel like quarreling over the price of the feedstock! We honestly believe that the way to maximize drilling everywhere within the continental U.S. is to immediately decontrol newly discovered natural gas. We continue to be amazed at some of the arguments made against decontrol. Consider, as we did, that when the oil companies bid slightly less than 3/4 of a billion dollars for drilling rights in the area west of Tampa, Florida, and south of Mobile, Alabama, that we thought our answers were at hand. Many geologists felt that the natural gas in this area would be high in sulfur content and that was perfect for us. The production of phosphates with huge plants located near Tampa requires large amounts of sulfur and sulfuric acid. On the other hand, the Gulf coast area would be an ideal place to build ammonia plants. Our dreams and the oil company plans were for naught. After spending additional millions of dollars, no gas or oil was discovered in that area. Now many hope and pray that large amounts of gas will be found off the east coast. I would remind people, however, that this same high feeling was evident prior to the first drill rig striking a dry hole in the Florida-Alabama offshore areas. My point

is here that this is a very high-risk business requiring millions of dollars and certainly decontrol would do two things: 1. It would immediately encourage all out drilling; and, 2. It would hopefully give us, as an industry and our country, the promptest relief in obtaining new gas supplies and proven reserves.

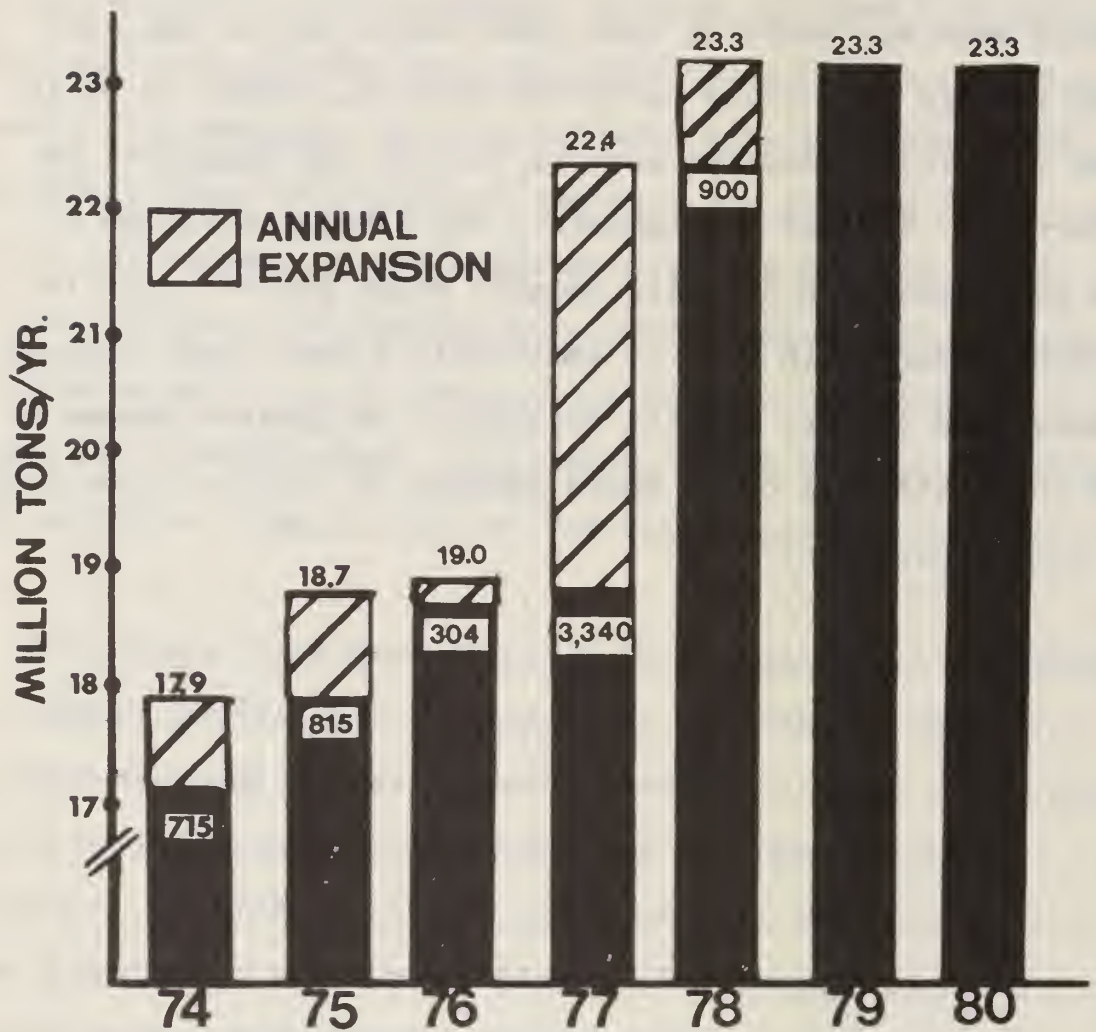
But all this is not enough. We have for some time been urging rapid development of coal gasification based primarily on coal. For example, we have met with the Tennessee Valley Authority's Board of Directors and they are seeking funds even at this moment to get underway with a long-term study and research project relating to alternate feedstock sources for these ammonia plants present and future. We think it is imperative therefore that a bill such as the one the Committee is considering today be adopted and without delay.

Many people have been critical of a proposal to guarantee this type of project but I think it is so patently obvious that were tremendous sums invested leading to final production only to have Canada or the Mideast, or for that matter Venezuela, drastically cut the price of fuel it would make these investments totally worthless. I can think of no other industry which faces a similar threat. To me the guarantee is nothing but an insurance policy to prevent these overseas energy countries from destroying a fledgling new industry.

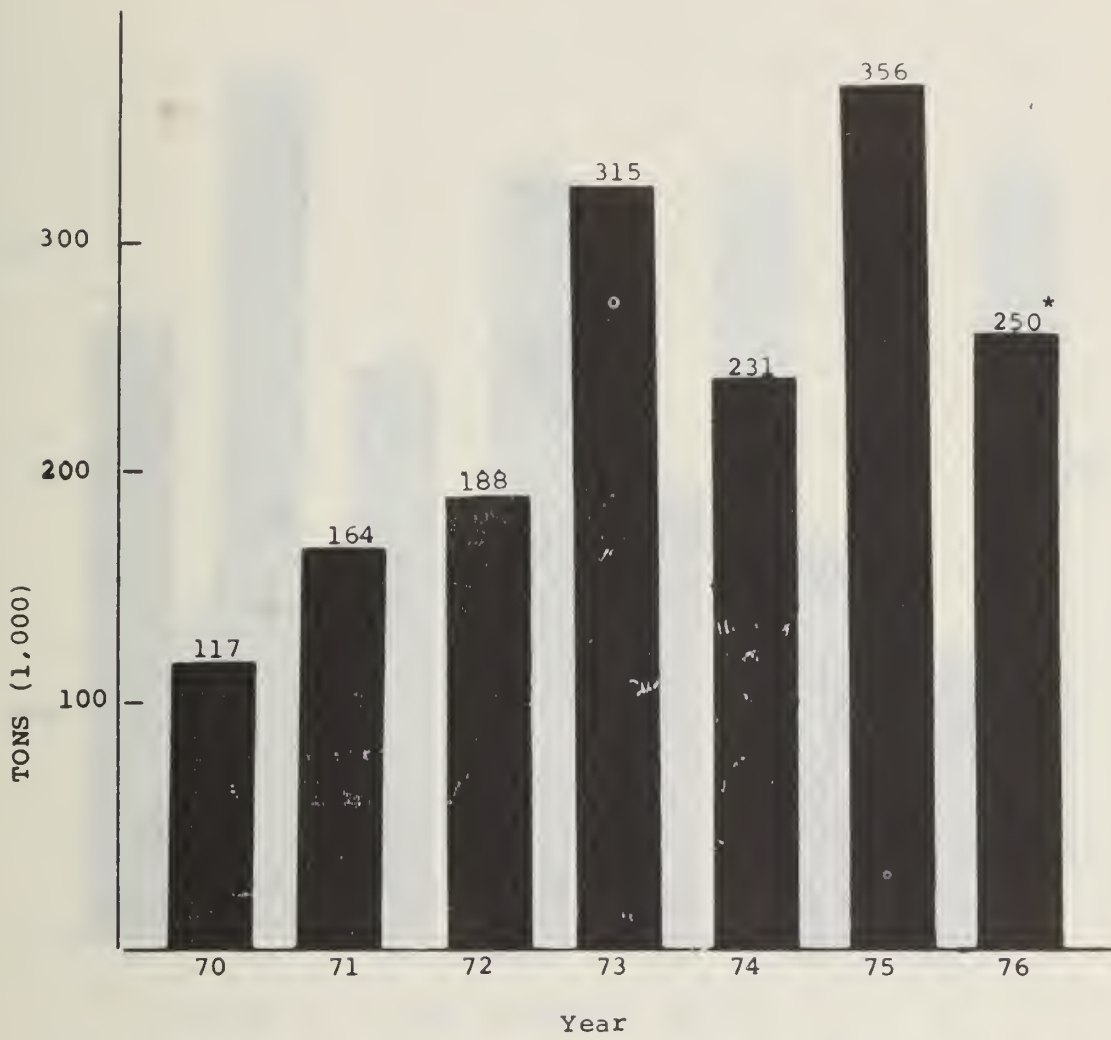
Six billion dollars in a guarantee form is insignificant when it involves the nation's ability to survive -- to feed itself. What a pittance when our way of life indeed our lives are involved.

Every one of us has decried the lack of an on-going, strong energy policy in this country. In retrospect we should have all realized that there would not be one nice neat package that would solve the problem, rather it would come in several measures such as the one the Committee has before it. We urge the immediate and favorable action of the Committee on H.R. 12112 because every day of delay in getting underway in what is admittedly a very large program, places this country and its population in greater danger of the thing that all of us would shudder to think of, the loss of food production.

U.S. ANHYDROUS AMMONIA CAPACITY

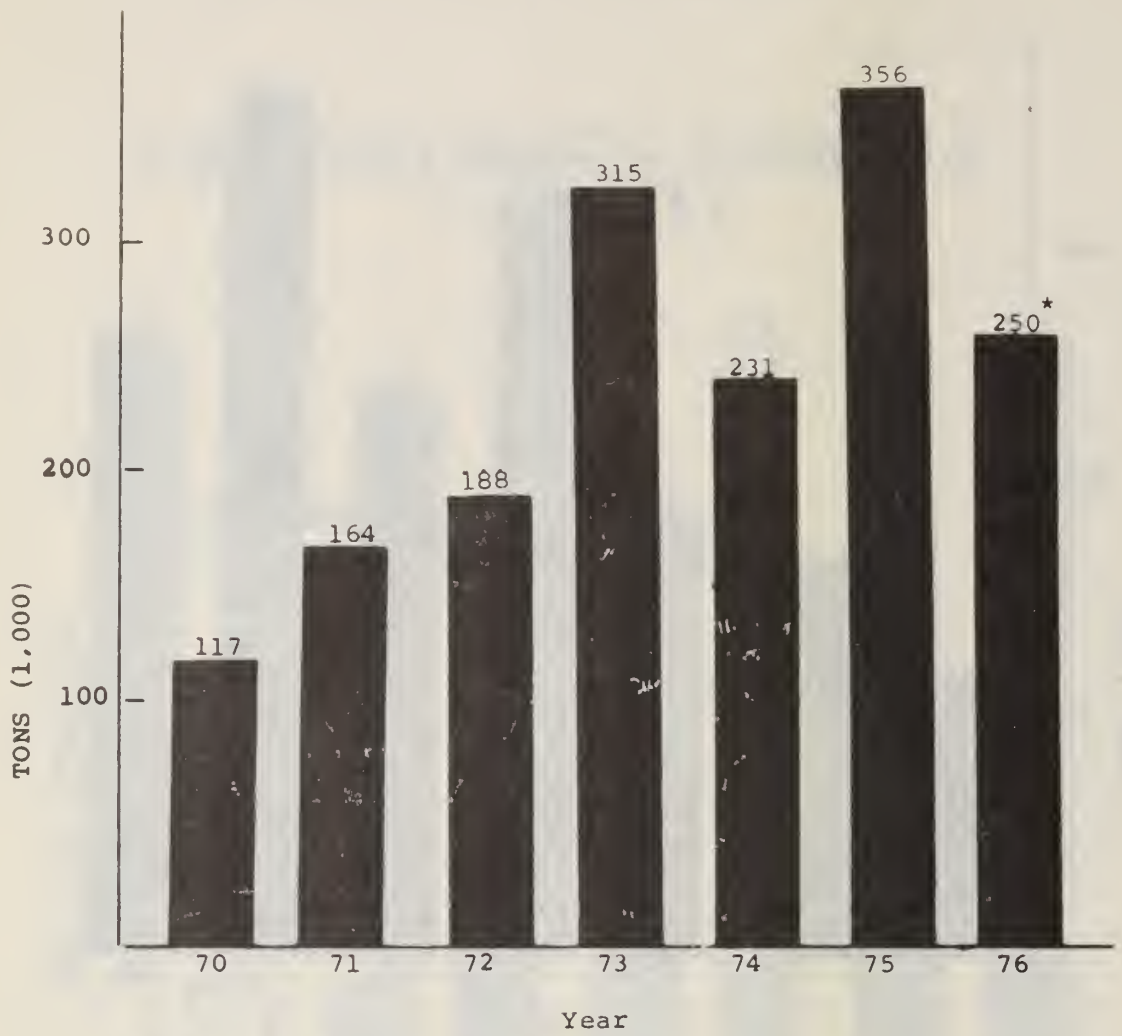


Anhydrous Ammonia Production losses
due to natural gas curtailments



*estimate

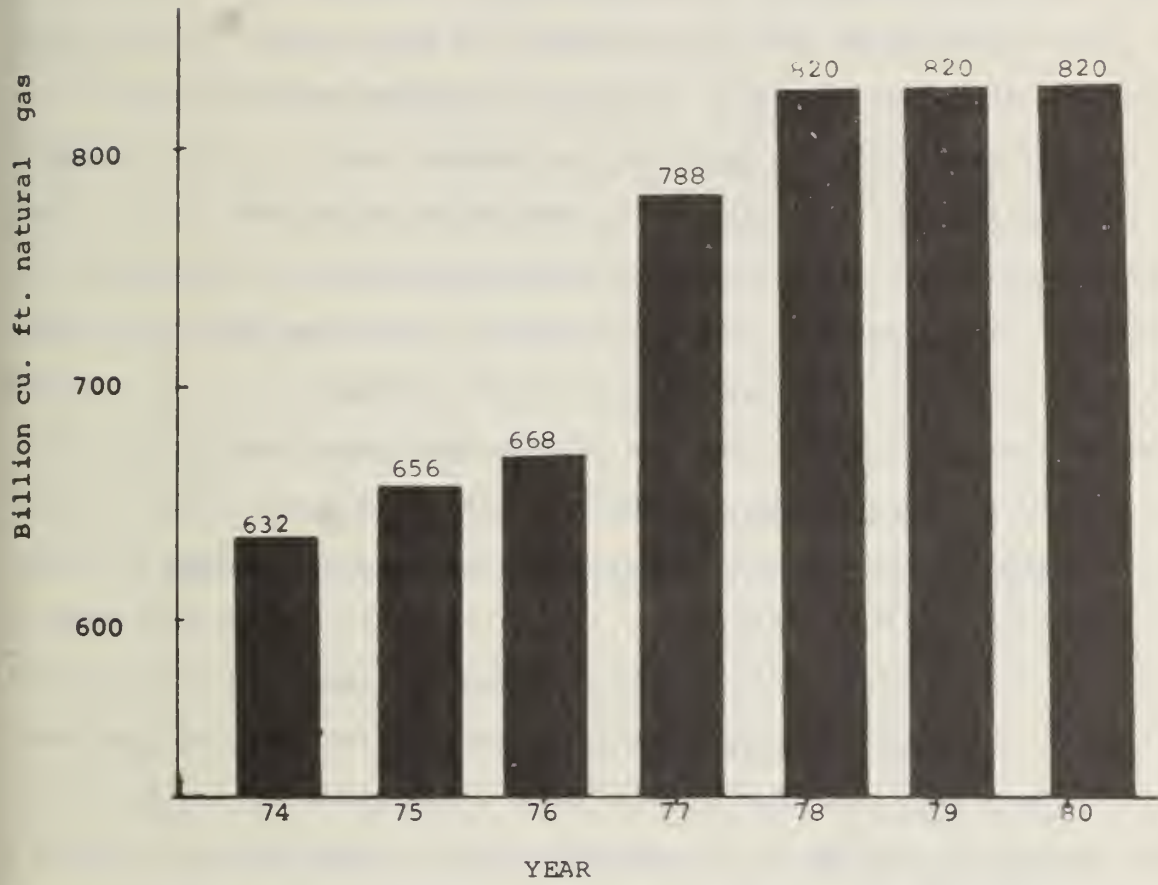
Anhydrous Ammonia Production losses
due to natural gas curtailments



*estimate

CHART III

Natural gas* for projected ammonia production
based on announced capacity expansions



* 40,000 cu. ft. gas per ton of ammonia

STATEMENT OF
THE HON. OLIN E. TEAGUE, CHAIRMAN
COMMITTEE ON SCIENCE AND TECHNOLOGY
BEFORE THE
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE
MAY 27, 1976

Mr. Chairman, I welcome this opportunity to appear before your Committee to testify on behalf of H.R. 12112 as reported, the loan guarantee program for synthetic fuels which was reported from the Committee on Science and Technology on May 12. The proposal contained in this bill has been the subject of extensive hearings before our Committee in this Congress, and the language that is in the bill before you is the product of many months of work. This work began in the last session of Congress after the Senate passed a loan guarantee provision, section 103, as part of the Energy Research and Development Administration authorization bill, H.R. 3474.

Mr. Chairman, before addressing the need for this legislation, I thought I should first review for the Committee the genesis of this legislation, since it is a subject which has come up in the House before. Last year, the Senate Interior Committee, chaired by Senator Henry Jackson, included a loan guarantee provision which became known as section 103. That section provided for six billion dollars in loan guarantee authority and included a program to produce synthetic fuels from coal and oil shale and to

support enterprises seeking to utilize renewable energy resources on a commercial scale to generate power or heat. The text of the Senate amendment came from an earlier legislative package which was sponsored by Senator Jennings Randolph which is referred to as the Synthetic Fuels Act of 1975, S. 2066, introduced July 8, 1975.

The executive branch initiative on a synthetic fuels program was enunciated some months earlier by President Ford in his 1975 State of the Union Message. At that time, the President proposed a national synthetic fuels commercialization program capable by 1985 of producing one million barrels of synthetic fuels and shale oil per day. After the ERDA authorization bill passed the Senate by a vote of 92-2, the House Conferees were faced with the consideration of a loan guarantee program in the Conference on which no work had been done in the House. Therefore, we delayed the Conference Committee meeting until such time as our Subcommittees had an opportunity to look at the program and to hold some hearings of their own so that we would have a better base of information about what the program contained before going to Conference.

As a result of this work by our Subcommittees last fall, we heard more than 100 witnesses, and have printed three volumes entitled "Loan Guarantees for Commercial Size

Synthetic Fuels Demonstration Plants" which were hearings conducted by the Subcommittee on Energy Research, Development and Demonstration (Fossil Fuels), chaired by Ken Hechler, and four volumes entitled "Loan Guarantees for Solar Energy Demonstrations," "Geothermal Energy Research, Development and Demonstration," and "Loan Guarantees for New Energy Technologies -- Capital Formation," and "Loan Guarantees for Energy Conserving Technologies," which were hearings conducted by the Energy Subcommittee chaired by Mike McCormack. After these hearings the Conferees met and put together a much improved legislative provision. At this time, too, we coordinated with other House Committees to do everything we possibly could to overcome their objections and incorporate their suggestions.

In this session, we have held six full Committee hearings on H.R. 12112, and spend many exhaustive hours perfecting the language in markup sessions before reporting it out of Committee on May 12 by a vote of 27-8. The report that accompanies our bill, H.R. 12112, reflects this effort. To sum up the work of our Committee in receiving testimony, we have heard from a host of witnesses who represent Federal, local, and State government, industry, financial institutions, labor, environmental groups, Indian tribes, and other individuals, associations, and groups.

Mr. Chairman, we feel that our hearing record is exceptionally complete. We are proud of the work that we

have done; we feel that it is thorough and the program contained in the bill, H.R. 12112, is not hastily conceived or developed with narrow vision. It is a broad-gauge program which will permit construction of a few large plants at a size large enough to determine the economic and environmental questions that surround them. In addition, it provides for community impact moneys to make sure that people and the regions of the country that may be affected are considered as well.

Mr. Chairman, this leads me into a discussion of why the Committee believes that this loan guarantee program is required in order to initiate demonstrations at full size of promising energy technologies. It is true that since the Arab embargo of 1973 some of the pressures for moving ahead quickly have relaxed. Today the gasoline flows into automobile tanks of Americans at a price which is only slightly above those pre-embargo days in 1973, and we were blessed with a mild winter. The wasteful over-consumption by our citizens continues.

We feel that the time to get started so that we have the technology capable of producing energy is now. We will need the technologies which can be built to produce synthetic fuels from coal, from oil shale, from urban waste, from the sun, and from geothermal resources. What we need now is to give the kind of financial assistance to

the private sector to begin this task by building a few plants to demonstrate that the technology can be made to run and that it can be made to run in an attractive economic and environmental way.

The Committee has not created a large program, although the figures seem high; four billion dollars does not build that many full size plants, since each high-Btu gasification plant is estimated to cost roughly \$1.2 billion. As we said in our report accompanying H.R. 12112, our limited program will result in about twenty-four different demonstrations to provide the experience and information needed. What we have heard from witnesses over and over again -- witnesses from industry who have testified -- is their statement that they are not in a position to finance the first-of-a-kind plants.

There are at the present time a number of serious impediments to private sector commercialization of synthetic fuels. The uncertainties surrounding future prices of world oil have a substantial effect on the investment climate for those facilities which would then be competing against foreign oil which would be underpriced. And in addition to the

financial risks and capital costs, there are numerous environmental uncertainties because of regulations that must be met as well as questions concerning the adequacy of available labor and materials. Our bill provides a means for the Government to reduce the risks sufficiently to allow these projects to proceed. Through the loan guarantee mechanism, the Government minimizes its involvement as well as minimizing the cost to the budget.

In addition to the assistance to the industry, the Committee deliberated at great length to provide the necessary social and economic impact assistance to reduce the impacts that concern people -- the impact of the host communities and on the regions of the country which have the resources but do not have the same kind of infrastructure and labor resources that exist in the more populated areas of this country.

Mr. Chairman, this is just one of the many programs which this Congress must pursue to meet the challenge posed by our dwindling supplies of oil and natural gas. While enhanced recovery and conservation measures will augment our supplies in the near term, they will not increase our supplies of these energy sources in the long term, by the year 2000. This program will provide the start for synthetic fuels which will be needed in this nation by the end of the century. This is the conclusion of not only numerous industrial energy consumers who testified before us, but also the conclusion of two Presidential Commission

reports -- one in 1952, the Paley Commission Report, and the other in 1975, the Inter-agency Task Force on Synthetic Fuels. Both reports concluded that this Nation will need to augment its energy mix with synthetic fuels by the year 2000.

Mr. Chairman, the legislation that we have reported out of our Committee has broad based support not only in the Committee itself, but from the National Governors' Conference, from labor, from the industrial community, from energy users, and from the financial community. The bill is one that I think your Committee will find is worthy of support. If there is anything that our Committee and its staff can do to assist you further in your consideration, we would be happy to help you in any way we can. Thank you.

Not to be released prior to
delivery on May 27, 1976 at
1:30 p.m., EDT

STATEMENT OF
DON S. SMITH, COMMISSIONER
FEDERAL POWER COMMISSION

HEARINGS BEFORE THE
SUBCOMMITTEE ON ENERGY AND POWER
OF THE
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE
U. S. HOUSE OF REPRESENTATIVES

May 27, 1976

Mr. Chairman and Members of the Committee, I appreciate the opportunity to testify before this Committee on the subject of Federal loan guarantees for demonstration of new energy technologies.

H.R. 12112, as reported by the Committee on Science and Technology, would make available up to \$1 billion per year for two years for loan guarantees on high Btu coal gasification projects. This is of particular interest to the Federal Power Commission, since coal gasification is at present the most promising of the fossil fuel conversion technologies because of our vast coal resources and because it is the synthetic fuel wherein the Commission's jurisdiction is likely to be invoked. Loan guarantees would inject a new element into Commission rate and public convenience and necessity decisions.

The predicted shortages of natural gas led the Commission to establish, as part of the National Gas Survey initiated in 1971, a Supply Technical Advisory Committee, which included a Synthetic Gas-Coal Task Force. This Task Force was asked to evaluate the technical and economic aspects of coal to gas conversion, to review the current and probable future state of the technology and to submit projections through the year 1990 relating to probable costs and commercial availability of gas produced from coal. The following table summarizes the Task Force's "best guess" projections of the cumulative number of plants, synthetic gas production capacity, and plant investment for the years 1975, 1980, 1985, and 1990.

<u>Year</u>	<u>Projected Plants In Operation</u>	<u>Production Capacity TCF/Year</u>	<u>Cumulative Plant Investment Billion Dollars *</u>
1975	None	None	None
1980	5	0.4	1.73
1985	16	1.3	5.87
1990	36	2.9	13.90

* Excludes costs of associated mines. Historically, mine investment has been about 10% of total plant investment.

It is interesting to compare the Task Force's 1980 projections of five plants producing .4 Tcf at a plant investment of 1.73 billion dollars with what now appears to be the case.

If the five plants include the three pending before the Commission at present, these three alone would require a plant investment of 2.7 billion dollars, substantially more than projected.

The Commission has established a Synthesized Gaseous Hydrocarbon Fuel Task Force as part of the continuing National Gas Survey effort. This Task Force will facilitate our continued evaluation of the technical and economic aspects of the conversion of coal, oil shale, liquid hydrocarbons, and other organic materials to synthetic gas.

In order to assess the value of the quantities of synthetic gas which are capable of being produced, these quantities must be related to the anticipated need for supplemental gas supplies. Synthetic gas will not be produced in sufficient volumes to completely offset the anticipated shortfalls of natural gas supply. Yet, synthetic gas, even in relatively small amounts, will provide critical and much needed increments of gas supply. The declines in production levels from traditional gas supply sources, necessitating curtailments of natural gas by interstate pipelines, have endangered and in many instances impaired the continuation of adequate service to America's gas consumers. It is unlikely that large increases in production from present

reserves in the lower 48 States can be achieved. Near-term increases in imports are unlikely, and in the long-term, uncertain. Experience teaches us that reliance on imports has its price, and I further believe that a domestic syngas capability will favorably affect import terms. Thus, if supply is to be increased significantly, it should come from accelerated development of new reserves from conventional supply areas and from commercial scale production of synthetic fuels. It is now clear that the technological, financial, environmental, and institutional problems related to the production of synthetic fuels must receive early attention due to the extremely long lag times which will be associated with this newly emergent industry and the earliest possible resolution of these problems will be required in order to reap the timely benefit of synthetic fuel supplies.

Before specifically addressing the merits of Federal loan guarantees under H.R. 12112, I would like to set forth the present regulatory responsibilities of this Commission with respect to coal gasification and other synthetic fuel projects.

In the past four years, the FPC has decided a number of questions concerning its jurisdiction over the production, transportation and sale of synthetic natural gas produced

from various feedstocks. In 1972, the FPC, in Opinion No. 637 ^{1/}, determined that the synthetic gas products of a manufacturing process which converts naphtha feedstock into synthetic gas of a high Btu content was not "natural gas" within the meaning of the Natural Gas Act. ^{2/} This decision was essentially based on the following factors. First, the process employed involves naphtha feedstock and naphtha does not contain methane, the principal component of natural gas. The process of transforming naphtha into methane involves a manufacturing process which rearranges the molecular structure of the feedstock. The Commission found that that which was produced by the manufacturing process could not be equated with that which occurs naturally. Having determined the end product to be artificial gas, the issue became whether Congress, in establishing the Commission's jurisdiction by virtue of promulgation of the Natural Gas Act, intended to include within the FPC's jurisdiction synthetic or artificial gas. After an evaluation of the legislative

^{1/} 48 F.P.C. 1216 (1972).

^{2/} Section 2(5) of the Natural Gas Act defines natural gas as ". . . either natural gas unmixed, or any mixture of natural and artificial gas.

environment out of which the Act 3/ was promulgated, the FPC concluded that the clear intent of Section 2(5) of the Act was to extend the Commission's jurisdiction to:

(1) natural gas unmixed with artificial gas; and (2) any mixture of natural gas and artificial gas. By exclusion, gas which is artificial, i.e., that which is manufactured, is outside the Commission's jurisdiction. The FPC found that: (1) the construction and operation of a plant for synthetic gas production are nonjurisdictional acts; (2) the synthetic gas produced is not natural gas as a matter of law; (3) the transportation and sale for resale of synthetic gas while unmixed with natural gas is nonjurisdictional. The Commission further found, however, that where synthetic gas is introduced into a pipeline and commingled with natural gas, the interstate transportation and sale for resale of the mixture is clearly jurisdictional.

In 1973, the Commission again faced questions concerning its jurisdiction over synthetic gas. This time, the questions concerned the Commission's jurisdiction over the production, transportation and sale of unmixed synthetic gas produced from coal. In Opinion No. 663 4/, the Commission

3/ See H.R. 5423, 74th Cong., 1st Sess.(1935); H.R. 11662, 74th Cong., 2nd Sess.(1936); H.R. 4008, 75th Cong., 1st Sess.(1937).

4/ 50 F.P.C. 651 (1973).

concluded that coal gasification plants produce artificial gas within the meaning of Section 2(5) of the Natural Gas Act and, therefore, the feedstock, the coal gasification plant, the facilities used for the transportation of the artificial gas when unmixed with natural gas, and the sales thereof when unmixed are not within the Commission's jurisdiction. The FPC further concluded that only when mixed with natural gas in a jurisdictional pipeline does the mixture become jurisdictional. Its decision again was based upon an examination of the gasification process, the conclusion that the process clearly results solely in the production of artificial gas, and the legislative history behind the Gas Act demonstrating Congressional intent to exclude from the Commission's jurisdiction artificial gas which has not become mixed with natural gas. It should be noted, however, that the Commission's regulatory authority over pipeline rates to resale customers requires continuous monitoring of the cost of artificial gas, when commingled with natural gas, to the pipeline.

The FPC's findings in Opinion No. 663, supra, were affirmed by the United States Court of Appeals for the District of Columbia Circuit in Alice Henry, et al. v. Federal Power Commission, 513 F.2d 395 (July 28, 1975). The Court therein

agreed with the Commission's jurisdictional analysis and concluded that under the Natural Gas Act, the Commission does not possess any jurisdiction over any aspects of synthetic or artificial gas until such gas is commingled with natural gas.

The Current Status Of Applications Before The FPC--Proposed Coal Gasification And Other Synthetic Fuel Projects

At present, five applications are currently pending before the Federal Power Commission. These are summarized below:

- (1) Transwestern Coal Gasification Company,
Pacific Coal Gasification Company, and
Western Gasification Company;
Docket No. CP73-211;
Filed February 7, 1973.

In this docket, Transwestern Pipeline Company filed for authorization to construct and operate about 67 miles of 36" pipeline and related facilities for the transportation of approximately 250,000 Mcf per day of gas derived from a coal gasification project in San Juan County, New Mexico, and for the resale of such gas in a commingled stream in interstate commerce. Certificate authorization was also sought for tap and valve facilities at the point of interconnection between the 67-mile pipeline and Transwestern's existing system. The coal gasification facilities were the subject of a separate

application in Docket No. CP73-212, filed by Transwestern Coal, Pacific Coal, and Western Gasification. In Opinion No. 663, supra, the Commission concluded that the gasification plant and the 67-mile pipeline were nonjurisdictional, so that only the connecting tap and valve and the transportation of SNG by Transwestern Pipeline remained as the subject of Docket No. CP73-211.

On November 16, 1973, an amended application was filed in CP73-211, wherein Transwestern Coal and Pacific Coal sought authorization for the sale of SNG directly to Transwestern Pipeline customers, Pacific Lighting Service and Cities Service Gas Company, with Transwestern Pipeline seeking to provide the required transportation service. On April 21, 1975, the Commission issued Opinion No. 728 (Attachment), wherein it approved the proposed project subject to certain conditions. One of the major problems the FPC faced in reaching its decision in Opinion No. 728 was the overall financial viability of a coal gasification facility. The applicants, in the proceeding before the FPC, had asserted that the viability of the project depends, of course, on its financing and its financing depends on the FPC's approval of a full cost of service tariff regardless of the amount of gas delivered. The applicants asserted that a

full cost of service tariff was the sole means by which the applicants could be assured of recovering all prudently incurred costs and expenses plus a reasonable return on equity in a prompt manner. Under a full cost of service tariff, they maintained that the Commission staff will have full access to all cost data on a continuing basis for review purposes.

Other parties to the proceeding, especially the Public Utilities Commission of the State of California, disagreed and asserted that Commission certification of the jurisdictional aspects of the proposal should be conditioned to provide initially for a firm rate which would assure the applicants a just and reasonable price for the gas, while at the same time providing adequate protection for the consumers against imprudent and improper expenses. The Commission adopted the California proposal as the most viable method of pricing this new source of supplemental supply.

Applications for Rehearing were filed by the principal parties to the proceeding. The applicants asserted that the conditions imposed by Opinion No. 728 foreclosed the investment

of capital by the private sector and further asserted that they would be able to obtain the necessary funds only if the Commission approved a cost recovery mechanism which would assure immediate recovery of all reasonable costs in producing each unit of coal gas.

Several parties proposed modifications and amendments to Opinion No. 728. Specifically, it was proposed that the initial rate should be increased from \$1.38 to \$2.50 per Mcf for deliveries during the testing period based on the 1975 coal contract amendment and the revised coal cost estimates. The Commission was also urged to adopt a minimum bill provision which would allow the full recovery of the cost of service attributable to the operation of the gasification plant. In other words, the minimum bill proposed was analogous to a tariff provision allowing the company to recoup all costs plus a return on equity of 15% except for a penalty provision which would have limited application. 5/

A significant aspect in the Commission's consideration of Opinion No. 728 was the parties' desire for Federal

5/ The proposed penalty provision provided for zero return on equity in the event that the load factor is reduced to 25% for a period of forty-five consecutive days for all deliveries subsequent to the aforementioned period.

assistance in financing the project. The parties asserted then and continue to assert that the project will not be built without Federal participation. Transwestern has stated that Federal participation is necessary to cover all residual exposure, i.e., risk of possible costs overruns, plant shutdowns and extended operations at abnormally low load factors which remain after the assumption of certain specific, ascertainable and acceptable risks by the applicants and the consumers. In addition, Transwestern wants the Federal Government to guarantee that if the project is not completed for any reason, construction lenders and investors will recoup their investment. In its pleadings, the California Public Utilities Commission for the State of California has asserted that there should also be a form of a guarantee by the Government to pay all or part of the costs of the project in excess of those that would justify a stated price per Mcf. The California Commission believes that the ratepayer needs the assurance that his cost for coal gas will not escalate beyond a certain level. All of the parties agree, however, that the Federal Power Commission should reserve the option to review the submitted financing plan. Applicants asserted that this would avoid any questions being raised in the future as to whether any particular financing

plan is in the public interest and involves obligations reasonably and prudently incurred.

On November 21, 1975, the Commission issued Opinion No. 728-A (Attachment). Therein the Commission increased the initial rate from \$1.38 per Mcf to 2.50 per Mcf, based on updated cost evidence, although it found that this rate will not allow a full recoupment of all costs plus a reasonable rate of return on equity. However, the Commission reasoned that the pricing mechanisms established in Opinion No. 728 would alleviate this problem.

The Commission also rejected the minimum billing provision proposed by the applicants on the basis that it inadequately protected the ratepayers; however, in order to assist the financiability of the project, the Commission devised a tentative minimum bill provision which would permit a recovering of funds should the heating value and/or content of SNG produced fall below the projected levels. The minimum bill provision devised was essentially a sliding-scale penalty provision which would operate as follows (Op. 728-A at 4):

If the plant output should fall below a seventy-five percent load factor, the return on equity and related taxes should be reduced by one-third or a level of 10 percent. If the output should fall below a fifty percent load factor, the return on equity and related

taxes should correspondingly be reduced another third or to a level of five percent. In the event that the output falls below a twenty-five percent load factor, all return on equity and related taxes should be eliminated. Correspondingly, should the heat content of the SNG fall below 950 Btu per cubic foot for a period exceeding 25 days, the return on equity should be proportionately reduced.

In Opinion No. 728-A, the Commission also stated, in response to the assertions that Federal financing is a necessary prerequisite to the project, that it would review any plan of financing when such plan reaches final form and further re-evaluate the above-referenced minimum bill provisions. Accordingly, the Commission conditioned the authorization granted in Opinion Nos. 728 and 728-A to review any proposed financing plan.

The certificates issued in Opinion No. 728 have not as yet been accepted. The applicants have recently filed a request for a six-month extension of time in which to accept the certificates. Applicants state that this additional time is needed in order to formulate a plan for financing and again reiterate that Federal financing is most likely a prerequisite to the construction of the project.

- (2) El Paso Natural Gas Company;
Docket No. CP73-131;
Filed November 15, 1972.

El Paso proposed to construct a coal gasification complex on the Navajo Indian Reservation near Burnham, New Mexico, for the conversion of coal into high Btu pipeline quality gas. In order to implement this project, El Paso sought a certificate of public convenience and necessity for (a) a mainline tap and valve to connect the proposed coal gasification complex to its Southern Division System; and, (b) transportation and sale of synthetic gas produced from coal and mixed with natural gas.

The project is designed to convert approximately 25,000 tons of coal per day into some 250,000 Mcf per day of synthetic pipeline gas, for use by El Paso in supplementing its declining gas supply. The indicated cost of the SNG to El Paso was initially estimated at approximately \$1.51 per Mcf.

Subsequent to the completion of hearings, briefing, Administrative Law Judge decision, and exceptions thereto, El Paso requested that the Commission hold in abeyance any final decision on its proposal in this docket, and on April 21, 1975, the motion to defer a decision was granted. The matter so rests, and no decision will be forthcoming until El Paso informs the Commission of its coal lease arrangements.

- (3) Michigan Wisconsin Pipeline Company and
ANG Coal Gasification Company;
Docket No. CP75-278;
Filed March 26, 1975.

Applicants seek authorization for sale by ANG to Michigan-Wisconsin of 250,000 Mcf per day of SNG produced from coal at a complex in Mercer County, North Dakota; and construction and operation by Mich-Wisc of pipeline and compressor facilities to enable it to receive and transport such gas to its existing customers. This proposal is currently in hearings before an Administrative Law Judge.

(4) Natural Gas Pipeline Company
Docket No. CP75-147

In this docket, Calorific Recovery Anerobic Process, Inc. (Calorific) proposed construction of plant facilities which will convert waste material into methane gas. Calorific has entered into a contract with Natural Gas Pipeline Company (Natural) whereby it will sell the gas produced at a base price of \$1.33. Natural intends to use this new source of SNG to augment its overall system supply and will purchase up to 3,500 Mcf per day, with an option to receive higher volumes, if available.

The production of this gas will entail the anerobic digestion process with several modifications. This basic process has been utilized in municipal waste treatment plants for many years. Although the plant process goes beyond the presently implemented state of technology, Calorific and Natural are confident of its success.

The projected cost of the project is about \$4 million. 6/ Calorific is willing to assume the risk of construction of the facility without Federal assistance. On May 24, 1976,

6/ The plant itself will cost approximately \$2.9 million and the pipeline to be constructed by Natural to connect the plant with the existing interstate system will be about \$930,000.

the Commission issued Opinion No. 763 (Attachment) in which we granted a certificate of public convenience and necessity authorizing the sale and transportation of the SNG commingled with natural gas at a total rate of \$1.55. 7/

The base price approved by the Commission is subject to adjustments as defined by three formulas. The first is a construction escalation formula, operable only once, on the day gas is first delivered or capable of being delivered. The second formula relates to the operation escalation and takes into account consumer prices. The third formula, also an operation escalation formula, is operable on an annual basis and takes into account annual delivery volumes.

The cost of this new supply will be recovered by Natural on a rolled-in basis. Natural had also proposed to pass through the increased costs resulting from the above adjustments automatically through either its purchased gas adjustment provisions or research and development cost-tracking provision. In Opinion No. 763, the Commission rejected this proposal finding it contrary to the public interest since the initial rate would be adjusted without FPC review and the FPC would be foreclosed from making any necessary rate adjustments other than prospectively.

7/ Natural will pay Calorific \$1.33 per Mcf which it will pass on to its ratepayers in conjunction with the cost of transportation of \$.22.

The Commission recognized that the initial rate may not allow full recovery of all costs during the period commencing plant operations and provided that (Op. 763, at 9):

Upon the commencement of initial deliveries from Calorific, Natural Gas Pipeline may file a revised tariff schedule under Section 4 of the Natural Gas Act in order for the Commission to make a determination of the just and reasonable rate. Any difference between costs reasonably and prudently incurred and the initial rate of \$1.33 shall be amortized at a rate not exceeding .05 cent per Mcf, over a period of one year or more.

- (5) Natural Gas Pipeline Company of America
Docket No. CP75-364
Filed on June 13, 1975.

This proceeding is similar in many respects to the previous proposal involving Calorific. Natural Gas Pipeline Company (Natural) requests authorization to construct and operate facilities for the receipt into its existing pipeline system of artificial gas to be purchased from ERA, Incorporated. The purchases contract specifies a base price of \$1.30 per Mcf subject to escalations which Natural again seeks authorization to recover through its purchased gas adjustment clause on a rolled-in basis. No action has been taken as yet on this proposal.

The Effect Of Various Costing Techniques Involved
In Gasification Projects

As can be seen, one of the most important issues facing the FPC with respect to the synthetic gas proposals is how to price the supplemental supply of gas in a manner which provides applicants the necessary financing to construct and operate the projects, ensures the applicants a just and reasonable price for the gas, and protects the consumers against imprudent and improper expenses. The companies who have applied for Commission authorization to sell and transport SNG from the coal gasification process have uniformly asserted that they are incapable of acquiring the requisite capital to construct the facilities through conventional means. As a result, they have requested full cost of service tariffs, regardless of the amount of gas delivered. The Commission has not chosen to adopt these tariffs, however, due to its concern that the rates may escalate beyond the zone of reasonableness to the detriment of consumers. 8/ The rate

8/ Because the costs of supplemental supplies have risen, necessitating subsequent filings for rate increases, and because of the inherent problems involved in an open-ended rate where there is a decrease in the load factor, the Commission cannot, if the rates are found to be excessive, rely solely on prospective relief. As the Supreme Court stated in Atlantic Refining Co., et al. v. Public Service Commission of New York, et al., 360 U.S. 378, 392 (1959).

If unconditional certificates are issued where the rate is not clearly shown to be required by the public convenience and necessity, relief is limited to Section 5 proceedings, and... full protection of the public interest is not afforded.

methodology chosen by the Commission has one possible drawback, however, and that is a potential inhibiting of investor confidence in these projects insofar as total recovery of costs are concerned. This lack of investor confidence in the private sector seriously threatens the progress of these projects.

There are a number of other interrelated characteristics which affect the viability of these projects. The capital requirements of these facilities are truly enormous when compared to the value of the plant-in-service. The estimated \$1.6 billion cost of a 250,000 Mcf/day facility of the size contemplated by those companies with applications pending before us exceeds the depreciated book value of the plant-in-service of most of the interstate pipeline companies. For the largest pipeline systems, a 250,000 Mcf/day increase in supply would not be a major increment.

Of major concern to investors are those problems associated with the construction phase. The lengthy period of construction provides opportunities for the favorable climate which supported initial investment to change. For example, construction delays can lead to cost overruns as can an increase in the rate of inflation beyond that contemplated in the project financing. Of course, all of these problems are exacerbated by the magnitude of capital commitment required.

Moreover, plant design does not lend itself to modular construction. As a result, the only alternative to completion of the facility is total abandonment.

Finally, there is the Lurgi process itself. While a broad spectrum of engineers and scientists, as well as the technical staff of the FPC, believe it highly probable that the facility will operate as designed and within reasonable financial operating parameters, and while the Commission has officially adopted this view, the fact remains that a full scale plant of the size and type contemplated has yet to be built and operated. It is not difficult for me to understand the reluctance of investors to commit funds to a project of such massive scale without actual operating experience as a guideline.

Once the plant is constructed and operational, the elements of risk shift primarily into the political and governmental arena. Governmental action in the environmental area, for example, could vitally affect the coal supply by driving up the cost of this feedstock to uneconomic levels or terminating it entirely. Shifting air or water quality regulations, particularly at the state level, could likewise increase operating costs and lower plant efficiency. Exposure of plant and feedstock to state and local tax changes adds another element of uncertainty. And, uncertainty over

regulatory policy at the state and Federal levels, as we at the FPC are painfully aware, can make investors extremely wary.

Finally, there is the question of whether the output of the facility will be marketable at currently projected prices in the mid-eighties. The pressure of the OPEC cartel has been a fact of life in recent years and has vitally influenced the rate of increase in energy prices. Whether the cartel will remain dominant through the life of the plant or whether other factors, now un contemplated, will be overriding are crucial considerations to investors, particularly those who act in a fiduciary capacity.

Investor risk and ratepayer exposure are also involved in the Commission's consideration of the question of whether such supplemental supplies should be priced on an incremental or rolled-in basis. The impact upon ratepayers is significant depending on which pricing mechanism is chosen and the choice further affects the risk to be accorded a project by investors.

Proponents of incremental pricing argue that supplemental gas supplies should be costed separately at its incremental cost plus a share of transportation costs and priced under

separate rate schedules to the pipelines' customers on the basis of such incremental costs. Only by such pricing, it is argued, will avoidance of discrimination (subsidization) and misallocation of resources be assured. It is also argued that incremental pricing will enable distributors to evaluate whether it is in their best interests and the best interests of customers to contract for a fully costed supplemental supply or seek other alternatives. Finally, incremental pricing is claimed to have advantages from a conservation standpoint.

Proponents of rolled-in pricing have responded to these arguments in a variety of ways. With respect to misallocation of resources, it is pointed out that pricing in the gas industry is already misallocating resources to the extent that prices are being charged that are far below the marginal costs of a supply that would result in market clearance rather than a large and growing shortage. They dispose of conservation argument by pointing out that the conservation incentive is lost unless the gas is priced incrementally to the retail customers, an undertaking which appears to present substantial administrative difficulty. In response to the argument that distributors should have "freedom of choice" to seek cheaper alternative supplies, it is argued

that most pipeline customers are not large enough to undertake projects of sufficient size to achieve scale economies. Thus, by impairing the ability of pipelines to engage in supplemental supply projects, incremental pricing will discriminate against all but the largest of the pipeline's customers. To the assertion that rolled-in pricing discriminates against high priority customers, incremental pricing supporters concede that while this may be true for a few years, supplemental gas projects provide high priority users with assurance of supply when needed in later years which is in the nature of gas supply insurance for high priority users.

The manner in which this controversy is resolved, in individual proceedings, impacts upon the risks accorded to supplemental gas supply projects by investors with the possible effect of further reducing, without Federal assistance, the financial viability of major supplemental supply projects.

One approach to reduce the risk involved and thereby instill more investor confidence in synthetic gas projects is to confer upon the Commission jurisdiction over synthetic natural gas, in the manner of Section 27 of S. 3422. Under that proposal the FPC would have authority to certificate the production, sales and transportation of synthetic natural gas in a manner similar

to that now applicable to natural gas. With this jurisdiction, the plants could be included in rate base and the investors would be allowed a reasonable rate of return on their investment. In the event of a plant failure, however, the unrecovered investment in the plant that was no longer useful would ordinarily be removed from the rate base. The question whether the write-off should be charged against consumers or stockholders would then become the subject of an adjudicatory proceeding. The write-off would take the form of an annual amortization deduction either "above the line", so that it would be included in the pipeline's cost of service, or "below the line", in which case it would be charged against stockholders' equity.

In view of the size of projects for the manufacture of synthetic natural gas in relation to the size of a typical pipeline company, the manner in which construction work in progress is treated for rate purposes by the Federal Power Commission will be of considerable significance. If an existing pipeline embarks upon a project for coal gasification, the project will become a part of the pipeline's rate base in a manner similar to ordinary pipeline facilities. Under present procedures, such property does not become a part of the rate base until it goes into service. Prior to that time, it is included in construction work in progress (CWIP) and accumulates

an allowance for funds used during construction (AFUDC). Thus, when CWIP is capitalized and placed into service, it includes AFUDC accumulated during the entire period of construction. In this way, rates charged to ratepayers do not include any payment related to the project until it goes into service. The utility companies in general would prefer that investments in CWIP be included in rate base as incurred. This would have the effect of eliminating any need to capitalize AFUDC. It would mean that rates would be somewhat higher during the period of construction of such a project but somewhat lower after the project went into service since there would then be no need for return and taxes on accumulated AFUDC. ^{9/}

If the FPC is not granted certificate authority over the construction and operation of gasification plants--in which case gasification plant investment would not be in the rate base--the synthetic gas might be sold with a provision for a minimum bill similar to that established in Opinion No. 728-A to cover the carrying cost on the plant investment. The minimum bill provision would become operable when output was curtailed or stopped because of production problems.

^{9/} At present, the Commission has before it the issue of the proper ratemaking treatment of CWIP under consideration in Docket No. RM75-13.

In sum, the capital intensiveness of these developing technologies, combined with investor uncertainty over inflation, high interest rates, governmental energy policies, and, in the case of gas producing technologies, lack of FPC jurisdiction, has cast a pall over the application and demonstration of these advanced technologies. The obstacles to large-scale financing of gasification plants cannot be overcome simply by augmenting the flow of internally generated capital. Because the technology of pipeline quality gasification has not been demonstrated and since we lack assurances that production costs will not require a price level unacceptable to the markets, corporations are asking that they be afforded substantial protection against the loss of their capital before they will invest in these plants. Protection against loss is necessary regardless of whether the capital is internally generated or borrowed from investors. Of the several possible methods of providing the needed protection against capital loss, loan guarantees of the type that are the subject of today's hearing would be the most effective. Loan guarantees would spread the risks involved more evenly, would insure the viability of the projects and would allow the continued protection of consumers who must begin to rely on supplemental supplies.

Recommendations and Analysis

H.R. 12112 would authorize loan guarantees to demonstrate full scale, commercial size facilities to convert fossil fuels, including coal to synthetic fuels. I believe it to be a very desirable and much needed program, one that is necessary in order to not only insure that such development materializes but also to accelerate the rate at which technologies progress.

In analyzing the bill, I am pleased to observe that up to 50% of the monies to be available can be allocated to High Btu coal gasification projects. As this Committee is well aware, a coal gasification project is extremely expensive. The proposals before the FPC illustrate that a project cost of at least \$1 billion will be standard. It is far from certain that these projects will go forward without some Federal assistance.

H.R. 12112 permits federal loan guarantees of up to 75% of the total costs of the projects. This is significant in two respects. First, quite obviously, it enhances the viability of the project by encouraging financial commitments from the private sector of the economy. Second, and equally as important, it could reduce the impact upon the consumers

who will rely on the synthetic gas since the cost of debt will be reduced according to the amount of federal participation. For purposes of gauging the effect on ratepayers of Federal guarantees, the Commission's Staff assumed that the cost of Federal guaranteed debt would be comparable to the cost of debt issued by the Tennessee Valley Authority (TVA). TVA debt at the time of the comparison was selling to yield approximately 9 percent. On the other hand, the cost of debt projected in the ANG application is 10.75 percent. FPC Staff calculates that a reduction from 10.75 to 9.0 percent would lower the projected cost of ANG synthetic gas by an average of about 5.5 cents per Mcf over the life of the debt, resulting in a total reduction in cost of gas purchased from ANG of about \$97 million. The actual reduction per Mcf would range from about 11.4 cents to .1 cent over this period.

One aspect of the bill troubles me, however, and that is the standards governing the Administrator's determinations on the guarantees. Any project which results in the transportation and sale of commingled synthetic gas and natural gas in interstate commerce must be scrutinized by the Commission through its certification process. As demonstrated by Opinion Nos. 728 and 728-A, the most difficult

problem in the certification process is the pricing issue. How the Commission establishes an initial rate and any subsequent rate for the sale of coal gas will be affected by any federal guarantees, since the presence of guarantees will affect not only debt costs but is likely to reduce financial risks which would otherwise have to be reflected in returns. Accordingly, while the Administrator's decisions will be influenced by the FPC's certification and rate action, the Administrator's action in granting or denying loan guarantees would be factors shaping the Commission's final action.

Under the specific provisions of H.R. 12112, Section 18(c)(1) through (7), the Administrator can guarantee an obligation only if the Administrator is satisfied that the federal assistance applied for is necessary to encourage financial participation. Moreover, the Administrator must be reasonably assured of repayment and any private financial commitments are subordinated to the federal obligation. Taking all of this as a whole, I would recommend a process whereby loan guarantees are conditioned upon the applicant obtaining from the FPC a conditional certificate of public convenience and necessity, under Section 7 of the Natural Gas Act, for the production, transportation and sale of synthetic gas prior to final approval of the loan guarantee.

This would entail extending FPC jurisdiction to synthetic gasification production facilities. The Commission's current regulatory authority over interstate pipeline rates to resale customers for SNG requires continuous monitoring of the cost of artificial gas to the pipeline, at which point it is commingled with natural gas. As such, the Commission of necessity must review many economic, environmental, and technical feasibility aspects of synthetic production facilities in approving the commingled transportation and sale of the SNG, underlying the need for supply and pricing of the gas. Accordingly, it would be appropriate for the FPC to examine not only the transportation and sale aspects of an SNG proposal, but also the production aspects as well, in terms of certification. In fact, intensive review of all aspects of the project has been necessary, without regard for jurisdictional limitations, since the rate to be determined is controlled by the costs of production. Moreover, the conditioned certificates issued by the FPC would provide guidance to the Administrator as to the technologies involved, the dimensions of the project, approximate costs and other financial aspects involved, and a tentative rate for the sale of the gas. The tentative rate established by the Commission could include a cost of capital slider so that

the rate could be adjusted depending upon the impact of the federal guarantees on the cost of debt for the project.

The intensive review of financial and technological feasibility that is already necessary by virtue of the Commission's certification process would accomplish two goals. First, it would facilitate the Administrator's determinations under Section 18(c)(1) through (7). Second, the public would receive full assurance, prior to any guarantees, that the projects receiving such guarantees are serving the public convenience and necessity and are best adopted to develop, conserve, and utilize the nation's resources.

In conclusion, I support Federal assistance as provided for in Section 18 of H.R. 12112, as reported by the Committee on Science and Technology. Such a loan guarantee program in concept can provide the much needed incentives to give this high-cost, relatively high-risk technology the boost necessary to make these facilities a reality, and I do not think it need become permanent. If the projects are successful, continuation of the guarantees will not be necessary. If they are not, continuation of the guarantees will not be justified.

My rationale for this conclusion is two-fold. First, there is the need for the gas. The social cost of converting present gas consuming equipment to alternate fuels is truly enormous. This, of course, assumes that such fuels are available, at any price. The additional increments of gas these facilities can provide can mitigate these costs to a certain extent. Secondly, the natural gas transmission system which has been constructed in this country over the last 30 years is truly a national resource and should be maintained. The present pipeline system offers advantages not enjoyed by any other transportation system. For example, the Committee is aware of several applications before the Commission in which natural gas pipeline companies are seeking to convert part of their unused capacity to carry crude oil or petroleum products. New technology may produce new fuels such as hydrogen or other non-fuel substances which can be transported most economically by pipeline.

Coal gasification facilities of the type this bill encourages would provide one means of increasing throughput sufficient to amortize the cost of the pipeline system. As the gas supply dwindles, the unit cost of delivering an Mcf of gas must inevitably rise to cover pipeline costs.

I urge your favorable consideration of H.R. 12112.

ATTACHMENT

UNITED STATES OF AMERICA
FEDERAL POWER COMMISSION

OPINION NO. 728

Transwestern Coal Gasification)	Docket No. CP73-211
Company)	
)	
Pacific Coal Gasification)	
Company)	
)	
Western Gasification Company)	

Issued: April 21, 1975

DC-51

UNITED STATES OF AMERICA
FEDERAL POWER COMMISSION

Transwestern Coal Gasification)	Docket No. CP73-211
Company)	
)	
Pacific Coal Gasification)	
Company)	
)	
Western Gasification Company)	

OPINION NO. 728

APPEARANCES

James W. McCartney, Jack D. Head and Joseph F. Weiler for
Transwestern Pipeline Company

K. R. Edsall and E. A. Tharpe for Southern California Gas
Company and Pacific Lighting Service Company

B.E. Potts, Alfred O. Hall, Daniel R. Hopkins, Dale A. Wright
and Harold L. Talisman for Cities Service Gas Company

C. Frank Reifsnyder, Samuel Shephard Jones, G. Scott Cuming,
Richard S. Morris and Richard Owen Baish for El Paso Natural
Gas Company

John P. Mathis, J. Calvin Simpson and William H. Booth for
The People of the State of California and Public Utilities
Commission of the State of California

John F. Harrington, Thomas F. Brosnan, Lawrence Robertson, Jr.,
and Steven M. Beattie for Tucson Gas and Electric Company

William D. Braun for the Staff of the Federal Power Commission

UNITED STATES OF AMERICA
FEDERAL POWER COMMISSION

Before Commissioners: John N. Nassikas, Chairman;
William L. Springer, and Don S. Smith.

Transwestern Coal Gasification)	Docket No. CP73-211
Company)	
)	
Pacific Coal Gasification)	
Company)	
)	
Western Gasification Company)	

OPINION NO. 728

OPINION AND ORDER GRANTING CERTIFICATION
OF TRANSPORTATION AND SALE OF GAS PRODUCED FROM COAL

(Issued April 21, 1975)

SPRINGER, Commissioner,

This is the first coal gasification case to come before us for decision. Coal gas is of major importance to the nation's capacity to produce energy today and in the future. The case itself poses a multitude of issues for our review and decision; however, the central questions are jurisdiction, pricing, the distribution of risk between the company and the consumers, the need for the project and the natural gas and synthetic gas supply alternatives.

Docket No. CP73-211

I. PROCEDURAL HISTORY

On February 7, 1973, under Docket No. CP73-212, Transwestern Coal Gasification Company (Trans Coal), Pacific Coal Gasification Company (Pacific Coal) and Western Gasification Company (Wesco) applied for certificates of public convenience and necessity to authorize the construction and operation of coal gasification facilities in San Juan County, New Mexico, and the sale of approximately 250,000 Mcf per day of gas derived from a coal gasification process, hereinafter referred to as SNG, for deliveries to be made at the outlet of the plant facilities. Concurrently therewith, Transwestern Pipeline, a subsidiary of Texas Eastern Transmission Corporation, in Docket No. CP73-211, filed for authorization to construct and operate approximately 67 miles of 36 inch pipeline and appurtenances for the transportation of such SNG and for the resale thereof in a commingled stream in interstate commerce. Certificate authorization was also sought for tap and valve facilities at the point of interconnection between the 67-mile pipeline and Transwestern Pipeline's existing system near Gallup, New Mexico.

On September 4, 1973, we issued Opinion No. 663 / in which we concluded that the coal gasification facilities and the 67-mile pipeline were not within our jurisdiction and therefore dismissed the application in Docket No. CP73-212. We also dismissed Transwestern's application in Docket No. CP73-211 insofar as it related to the 67-mile pipeline facility. Our opinion did not affect that portion of the application which related to the connecting facilities or the transportation of SNG after the commingling with natural gas.

Thereafter on November 16, 1973, Trans Coal, Pacific Coal and Wesco (Applicants) filed an amended application seeking authorization for the two coal companies to sell the SNG directly to customers of Transwestern Pipeline, Pacific Lighting Service Company (Pacific Lighting) and Cities Service Gas Company (Cities). Transwestern Pipeline sought authorization to provide the required transportation service.

/ El Paso Natural Gas Company, et al., 50 FPC 651 (1973), Appealed Alice Henry, et al. v. F.P.C., D.C. Circuit No. 73-2090 on jurisdictional and environmental issues.

Docket No. CP73-211

Eight days of hearing were held in December 1973, and February 1974. On June 13, 1974, the Presiding Administrative Law Judge William L. Ellis issued the initial decision granting the certificate contingent on specific conditions. Briefs on exceptions were filed by Pacific Coal, the Public Utilities Commission of and for the State of California (CPUC), El Paso Natural Gas Company (El Paso), Cities, Transwestern Pipeline and Staff. The Pipeline Coal Gasification Committee filed an untimely petition to intervene in conjunction with a brief on exceptions. _/ Briefs opposing exceptions were filed by Transwestern, El Paso, CPUC, and Staff. Oral argument was held on March 14, 1975.

II. THE PROPOSED PROJECT

The proposed coal gasification plant is to be located on the Navajo Reservation in northwest New Mexico. It will be capable of converting approximately 25,000 tons of coal per day into 250,000 Mcf of SNG daily, having a Btu content of approximately 970 Btu per cubic foot. During the hearing, the plant, including the 67-mile connecting pipeline, was estimated to cost \$447,000,000 based on mid-1973 estimates. Pacific Coal and Trans Coal have purchased from Utah International sufficient coal and water supplies to operate the plant for a period of 25 years.

Pacific Coal and Trans Coal each will own 50% of the plant's output. Pacific Coal will sell its SNG to Pacific Lighting whereas Trans Coal will sell one-half of its volumes to Pacific Lighting and the remaining volumes to Cities. The sale to Pacific Lighting will be made at an existing delivery point on the Arizona-California border, near Needles, California and the sale to Cities will be made at existing delivery points in the Panhandle areas of Texas and Oklahoma. The rates charged by Trans Coal and Pacific Coal to their purchasers will include transportation charges paid by them to Transwestern Pipeline. Based on mid-1973 cost figures, the calculated price per Mcf of the SNG to be produced in the Wesco plant would be

_/ The Committee consists of ten natural gas pipeline systems which are actively studying or have announced plans to construct and operate coal gasification plants in the western United States.

Docket No. CP73-211

\$1.317 including transportation costs; however, projecting inflation of 20% to 25%, Applicants estimated at time of hearing that the 1978 cost will range from \$1.60 to \$1.70.

The coal gasification complex will utilize the Lurgi gasification process. The process involves the reaction of coal, steam and oxygen under high pressure and temperature to produce a crude gas which, on a dry basis, consists primarily of hydrogen, carbon dioxide, carbon monoxide and methane. The crude gas is cooled and scrubbed with water and then delivered to the methanation unit which increases the heating value of the SNG to approximately 970 Btu per cubic feet.

The Lurgi process is currently the only coal gasification process with proven commercial experience. The methanation process, developed in conjunction with the Applicants, is alleged to be technically and commercially feasible and has been used in smaller units worldwide on experimental bases. It is estimated that thermal efficiency of the Lurgi gasification process is 87% whereas the overall efficiency of plant operation is 70%.

Coal and water are the two basic feedstocks for the proposed coal gasification project. Trans Coal and Pacific Coal have entered into an agreement with Utah International which will provide adequate supplies of these resources for the twenty-five year plant life. Utah International will supply the coal requirement from coal produced from its leasehold on the Navajo Reservation in the Four Corners Region of northwestern New Mexico. The base price under the contract, is 26.24 cents per million Btu for all coal delivered; however, the price is variable as it consists of eight components designed to reflect periodic changes in supply costs and economic conditions. ___/

Approximately 8200 acre-feet of water will be used annually by the project in order to produce 250,000 Mcf of gas per day. Utah International has assigned to Trans Coal and Pacific Coal an undivided interest in its water

___/ On March 7, 1975, the parties amended the Western Gasification Agreement No. 1, dated 1973, whereby the base price of the coal was increased from 20.8 to 26.240 cents per million Btu.

Docket No. CP73-211

contracts with the United States covering the purchase of water from the Navajo Reservoir and the San Juan River. _/ Trans Coal and Pacific Coal will pay Utah International \$7.00 per acre-foot for all water they are entitled to use in the project. Applicants estimate that the water used yearly represents only 1% of all the water in the upper basin of the Colorado River system which has been allocated to consumptive use in New Mexico in accordance with the Colorado River Compact of 1922.

The requested action of the F.P.C. is not a major federal action warranting the preparation of an environmental impact statement under the National Environmental Policy Act. Nor have any parties or litigants raise environmental issues in this administrative proceeding. The Bureau of Reclamation of the Department of Interior however is preparing a Final Environmental Impact Statement (EIS) in order to assess the impact of the entire project upon the existing environment. We have received a copy of the Draft EIS and are preparing our comments thereon as to the need for supplemental supplies of pipeline gas. In addition to the filing of the Final EIS with the Council on Environmental Quality, there are several actions which must be completed by Federal and state agencies before the Wesco plan may be implemented.

The primary federal approvals which must be received from the Department of Interior are these:

- (1) Bureau of Reclamation must approve Wesco's plan as provided in the water service contract;
- (2) U.S. Geological Survey must approve the mine development plan; and,
- (3) Bureau of Indian Affairs must give written approval of all land leases, rights of way, and access roads negotiated with the Navajo Tribe for the plant and the associated facilities.

None of the parties have asserted that an environmental impact study is required prior to our certification of the construction and operation of the Wesco plant as has been

_/ Under the contracts with the Department of Interior, Utah International has rights to 44,000 acre-feet per year of water and has assigned up to a maximum amount of 11,000 acre-feet of its supply for use in the construction and operation of the plant.

Docket No. CP73-211

argued in the companion coal gasification case, El Paso Natural Gas Company, Docket No. CP70-138. The primary distinction between these cases is that Wesco has been able to obtain commitments for adequate supplies of both coal and water from Utah International, which previously received the requisite authorizations from the Department of Interior. In short the purpose of the Bureau of Reclamation's EIS for the Wesco project is to assess the impact of the proposed utilization of these licensed resources rather than to determine whether the requisite authorizations should issue ab initio and thereby allow the use of previously uncommitted water and coal for energy production, as is the case in El Paso.

III. NEED FOR NEW SUPPLY

The SNG to be produced will be used to meet the requirements of customers on the systems of Southern California Gas Company (Southern California), an affiliate of Pacific Lighting, and Cities Service Gas Company (Cities). Three-fourths of this project supply, or 187.5 MMcf per day, will be purchased by Southern California and one-fourth, or 62.5 MMcf, by Cities.

Transwestern Pipeline was able to meet its contractual demands in 1973 by purchasing short-term and emergency supplies of gas, but began curtailing in January, 1974. Transwestern projects the following level of curtailment in the years in which the plant will become operative: __/

	<u>Annual Requirements</u>	<u>Annual Supply (MMcf)</u>	<u>Annual Deficiency (MMcf)</u>	<u>% of Curtailment</u>
1978	383,250	265,542	117,708	30.7
1979	383,250	239,500	143,750	37.5
1980	383,250	219,290	164,960	43.0

The output from the plant will utilize approximately twenty-five percent of Transwestern's pipeline capacity and thereby offset the projected levels of curtailment and reduce the Transmission costs resulting from underutilized pipeline facilities.

__/ Transwestern Pipeline Company 1971 FPC Form 15.

Docket No. CP73-211

Southern California is the nation's largest natural gas distribution company providing natural gas service to the central and southern parts of California. Submitted testimony projects that in 1979 there will be an insufficient supply of natural gas to meet the requirements of the highest priority customers which under the California system are usually residential customers.

There also will not be any gas available in 1979 for the "regular interruptible retail" class of customers which includes commercial and interruptible users. This class is composed of hotels, schools, and restaurants which provide employment in the California area. Furthermore, should 1977 be a cold year, curtailment of these customers could then occur.

It is further noted that in 1970, natural gas fulfilled 95% of the fuel requirements of the "regular interruptible retail" class of customers. Although this group is now required to have the capacity of burning alternative fuels, such fuels are not available in sufficient quantities for annual use to maintain all industry and commercial enterprises. It is also significant to note that none of the new supplemental supplies will be used as boiler fuel for utility electric power generation in southern California and that the Applicants specifically so state. _/

The Applicants estimate that the total annual gas supply available to Southern California Gas Company in 1981 from existing sources will be less than half of that available in 1972. There has been a drastic decline in the availability of California produced gas which has aggravated the shortage. Applicants further project that three coal gasification plants would be required to bring deliveries on Southern California's **system in 1978 up to the 1974 level.**

The projected supply of 62,500 Mcf per day for Cities will be used to offset projected curtailments in the existing system, not to enable Cities to render any new service. Cities renders natural gas service to Texas, Oklahoma, Kansas, Missouri and Nebraska. Cities projects that for the period of 1977-81, all of the SNG will be

_/ Initial Brief, p. 26.

Docket No. CP73-211

used on peak days to reduce curtailment of priority one customers; however, the curtailment of this class will not thereby be eliminated. From the foregoing, we conclude that this project is an absolute necessity for the consumers in California and the Midwest, absent the availability of equivalent sources.

IV. JURISDICTION

A primary question that confronts us is whether the proposed sales by the Applicants is subject to the Commission's jurisdiction. Relying on Opinion No. 663 __/, Staff asserts that the Commission is without jurisdiction. Staff argues that the following statement in the opinion precludes us from regulating the sale, "...there can be no such thing as the sale of synthetic gas mixed with natural gas". __/ Staff admits that when the coal gas is introduced into the Transwestern Pipeline and mixed with natural gas the total supply becomes natural gas.

In its Brief opposing Exceptions, Transwestern asserts that the Commission settled this issue in Opinion No. 663 wherein the Commission stated:

We exercise certificate authority over the interconnection facilities necessary to permit mixing of the artificial gas with the natural gas, over the transportation facilities and any applicable transportation rate after mixing, and over the rate at which the artificial gas is sold for resale in interstate commerce after mixing with natural gas. __/

In Opinion No. 663, we stated the jurisdictional boundaries of our regulation of synthetic natural gas and intended to do so clearly. In the instant case, the sales to Pacific Lighting

___/ El Paso Natural Gas Company, et al., Opinion No. 663, 50 FPC 651 (September 1973).

___/ Brief on Exceptions, p. 3.

___/ 50 FPC 651, 664.

Docket No. CP73-211

and Cities will occur after the SNG and natural gas have been mixed within Transwestern's pipeline and are therefore clearly within the parameters of our jurisdictional boundaries. _/

Staff attempts to buttress its argument by asserting that the sale is not subject to curtailment. It further argues that because Pacific Coal and Trans Coal do not own jurisdictional facilities, they cannot make jurisdictional sales. _/ Neither argument is persuasive or relevant to the issue of whether the sales are jurisdictional. The Staff's argument with respect to curtailment is somewhat confusing. It is implicit that a supplemental supply source offsets curtailment and the Applicants herein have made this argument.

The second argument regarding jurisdictional facilities is also unclear. We have addressed this issue directly in Opinion No. 663 wherein we stated that we would exercise certificate authority "over the rate at which the artificial gas is sold for resale in interstate commerce after mixing with natural gas". The fact that we have not assumed jurisdiction over the project itself does not foreclose our asserting jurisdiction over the rate to be charged to the purchasers.

In conjunction with the jurisdictional issue, we are confronted with the problem that Cities will not receive the SNG which it purchases but rather will receive gas through displacement deliveries. Although Cities will purchase 62,500 Mcf per day from Trans Coal, it will actually receive displacement deliveries from the seller at two delivery points. The total output from the coal gasification plant will be delivered through a commingled stream to Pacific Lighting.

In the Initial Decision, the Presiding Judge issued a certificate allowing Transwestern Pipeline Company to transfer and deliver to Cities "at the existing points of delivery in Texas and Oklahoma, a quantity of natural gas equal in heating value to the quantity of coal gas" _/ referred to in their

_/ The jurisdictional issue presented herein is distinguishable from that in Columbia LNG Corporation, Opinion No. 699, 50 FPC 1252, reh. den. Opinion No. 699-A 50 FPC 1943 (1973). In the latter case, the sale of the SNG occurred at the tailgate of the reforming plant unmixed with natural gas and was therefore clearly outside the Commission's jurisdiction.

_/ The Saturn Oil and Gas Company v. F.P.C., 250 F. 2d 61 (10th Cir. 1957), cert. denied, 355 U.S. 956 (1958).

_/ Mimeo, p. 47.

Docket No. CP73-211

agreements. In its brief on exceptions, Cities asserts that the Judge erroneously concluded that Cities would not purchase SNG from Trans Coal. Cities maintains that the certificate prescribed by the Judge should be amended to expressly authorize the sale of SNG by Trans Coal directly to Cities.

Cities argues that the receipt of displacement gas will place it in the same position as the physical receipt of SNG volumes and further that the necessity of cross-hauling natural gas and SNG will be eliminated. That Cities will not physically receive the SNG, does not, in Cities' view, bar or preclude a sale-purchase transactions between Cities and Trans Coal.

The only other party to the proceeding to address this issue is Transwestern who supports Cities' position. Transwestern argues that as there is no legal difference between natural gas and a mixture of natural gas and coal gas; therefore, there should be no conceptual difference between Cities' and Pacific Lighting's transactions.

By order issued May 29, 1974, the Commission deferred consideration of a separate application filed by Cities, in Docket No. CP74-185, to construct facilities to transport volumes of gas purchased from Trans Coal. Transwestern, Cities, and Pacific Lighting have agreed that should such authorization not be issued by the Commission or should Cities not accept it, Pacific Lighting should be entitled to purchase Trans Coal's entire portion of the plant output. They argue that the certificate authorization should be conditioned accordingly and Cities' interest in the project would thereby be protected while any source of possible delay or uncertainty would be removed.

We find that the certificate should be amended as suggested by Cities. A denial of the certificate would endanger Cities receiving the additional supply of gas and would operate as a penalty to its customers whereas the allowance of the displacement deliveries will eliminate unneeded transportation expense.

IV. PRICE

The central issue in this proceeding is the pricing of the SNG. Pacific Lighting and Cities have agreed to purchase the entire plant output on a cost of service basis. The proposed tariff provides that these buyers shall pay monthly the sellers' total cost of service, including a 15% return on equity, regardless of the amount of gas delivered. Non-delivery for any reason, including force majeure, does not relieve them of their obligation.

The Applicants have asserted that the foregoing pricing provision is a prerequisite to the method of financing this operation, which they have termed "project financing". Project financing guarantees the investors the recoupment of all monies invested in the project by the end of the initial 25 years of plant operation. Specifically, the plan for financing proposes the issuance of 25-year bonds worth \$342 million at a hypothetical rate of 8-1/2% and the subscription to \$114 million of stock by Pacific Coal and Trans Coal. The plan provides for the bonds being sold to institutional investors on a private placement basis. The capital structure will therefore consist of approximately 75% debt and 25% equity.

Fifty-seven per cent or \$72,606,000 of the estimated annual cost of service is fixed costs which include depreciation, taxes, and return. The annual operation and maintenance expenses, \$51,548,000 or 43% of the cost of service, are subject to inflation. It is noted that the coal contract is included as a variable item. The Judge, however, estimated that if the latter expenses increased 40% over the next 10 years, the total cost of service would increase only 17.2%.

The Applicants vigorously assert that the viability of the project depends on its financing and its financing depends on the Commission's approval of a full cost of service tariff. They argue that they are incapable of acquiring the requisite capital through conventional means so that the project must be economically self-sufficient in order to attract sufficient capital on terms favorable to the investors. They argue further that any additional conditions that this Commission may attach to their proposal to protect the consumers against future cost increases will in and of themselves increase the financing

Docket No. CP73-211

costs by causing the interest cost to rise. A full cost of service tariff is the sole means by which the Applicants say that they can be assured of recovering all prudently incurred costs and expenses plus a reasonable return on equity in a prompt manner. Under a full cost of service tariff, they assert the Staff will have full access to all cost data on a continuing basis for review purposes.

In the Initial Decision, the Judge ordered that within 6 months of the proposed start-up date, the parties should submit a proposed price which would operate as the initial rate until a subsequent filing was made pursuant to Section 4. In deriving this pricing mechanism, the Judge reviewed prior Commission decisions on supplemental supply programs, ___/ which disallowed cost of service tariffs and established fixed initial rates.

The Judge prescribed the following conditions, stating:

(K)(1) While it would be premature now to pinpoint a specific price, by the time the works are nearing completion and within six months of the proposed start-up date, the parties may readily compute an initial price per Mcf or, preferably, per MMBtu, and submit it for immediate and final approval by the Commission, along with a memorandum detailing how it was computed and reciting also the final financing arrangements that have been made. That initial rate will control as the filed tariff until it shall be changed under the authority of the Natural Gas Act.

(2) If increases are later found to be required to recover the cost of service, the interest and the equity return contemplated, the new rate may be computed and filed as an increased tariff, subject to review and control here under Section 4...(emphasis added). ___/

___/ Distrigas, Opinion No. 613, (1972); Columbia LNG, Opinion Nos. 622 and 622-A, (1972); Algonquin SNG, Opinion Nos. 637 and 637-A, (1972-1973); Tecon, Docket No. CP72-100, Order dated February 25, 1974.

___/ Mimeo, p. 42.

Docket No. CP73-211

The Judge was unconvinced by the Applicants' argument that project financing was essential. Rather he compared the project to the building of toll roads, bridges or pipelines which have historically been financed by conventional means. He concluded that full cost of service treatment was inappropriate and a just and reasonable rate should be established. He was, however, unwilling to speculate about the level of the rate and directed the parties to make a filing which appears to allow the Applicants to charge initially whatever price they are able to justify.

Staff concurs in the Judge's rejection of the full cost of service tariff. Staff asserts that the Commission's continuing surveillance over the rates charged under a full cost of service tariff would be legally insufficient because if the Commission found the Applicant's rates to be excessive, its single course of action would be to institute a Section 5 proceeding which would grant only prospective relief. Citing Catco, Staff asserts further that the Supreme Court effectively expressed its disapproval of full cost of service tariffs in the following statement:

If unconditional certificates are issued where the rate is not clearly shown to be required by the public convenience and necessity, relief is limited to Section 5 proceedings, and ...full protection of the public interest is not afforded. ___/

Staff foresees that if there were a severe and pronounced decrease in the load factor, an open-ended rate would thereby be created under a full cost of service tariff which would escalate automatically and indefinitely. This is a risk which we cannot ignore.

Staff maintains further that a finding of public convenience and necessity is impossible unless a rate condition is attached to the Applicants' certificates. Citing the Commission's decisions in other synthetic gas supply cases, the Staff maintains that a rate condition is "absolutely necessary to protect the public interest". Staff asserts that the Judge failed to comply with the court's requirement set forth in Catco as to giving "a most careful scrutiny and reasonable reaction

___/ Atlantic Refining Co., et al. v. Public Service Commission of New York, et al., 360 U.S. 378, 392 (1959).

Docket No. CP73-211

to the initial price proposals". Staff further objects to the Judge's provision for an initial rate filing six months prior to commencement of operation on the basis that the filing could not be suspended and the initial rate would be reviewable only in subsequent Section 4 proceedings.

CPUC took an active part in the proceeding and advocated a pricing mechanism which differed from that proposed by the Applicants, Staff or the Judge. CPUC proposed that the certificate should be conditioned upon an initial rate of \$1.32 for all sales occurring during the start-up period. Those costs attributable to the start-up period, which are not recovered by the sales, shall be amortized over the life of the project and recovered through rates established in a subsequent Section 4 proceeding.

CPUC joined Staff in its arguments against a full cost of service tariff and took exception to the Judge's resolution of the price issue due to its lack of clarity. The project itself will require a period of testing before it is capable of sustained full production, therefore CPUC asserts that it is necessary to distinguish between the commencement of the testing operations and the commencement of full scale production. The Judge did not define the phrase "start-up date" which he used in directing the Applicants to file an initial rate.

CPUC maintains that if the Judge intended the "start-up date" to be the beginning of the testing operations, the initial price would have to be determined without information as to the plant's performance and without provision for recovering excess costs. On the other hand, if the Judge intended the "start-up date" to mean full scale operation, he did not make provision for the sale of gas produced during the testing period. To eliminate this apparent ambiguity in the initial decision, CPUC advocates that the Commission should establish an initial price of \$1.32 per Mcf for the testing period and provide for a Section 4 rate hearing to be commenced during the testing period.

CPUC objects to the Staff proposal on pricing on the basis that the Staff proposal would require the Commission to make an accurate determination of the cost of producing the SNG three years before the sales commence. CPUC agrees that Catco

Docket No. CP73-211

is applicable to the extent that the Commission must analyze costs and make a determination as to whether the sale will be in the public interest, however, CPUC maintains that the Presiding Judge has done this. Although CPUC agrees with Staff that initial price should be set out in the certificate, it asserts that its proposal is a more effective pricing mechanism which fully complies with Catco.

CPUC cites Judge Levant's Initial Decision in El Paso Natural Gas Company, Docket No. CP70-138, as containing a pricing provision essentially similar to their proposal in this case. El Paso's contracts set an initial price of \$1.40 per Mcf during the "start-up period" (or testing period) which precedes the date of the First Regular Delivery. Judge Levant directed El Paso to make a rate filing pursuant to Section 4, no later than 30 days prior to the date of the First Regular Delivery, setting forth the cost of gas to be purchased and the actual costs incurred during the start-up period. Based on these figures, the Judge found that the initial full production price could then be realistically determined.

This is the first major coal gasification project to be constructed in the United States. Neither Pacific Lighting, the corporate parent of Pacific Coal, nor Transwestern Pipeline can guarantee repayment of the sums involved. In order to encourage investors to participate in a project of this experimental nature, which is non-jurisdictional, we recognize that they must receive some assurance of recovering their investment.

Furthermore, we are acutely aware of the need for this country to develop its own sources of energy. The coal gasification process is a means by which the United States may attain a greater measure of energy self-sufficiency and reduce its vulnerability through dependence on foreign markets. Coal gasification is one of the few potentially commercial means of developing a supplemental supply of gas from domestic resources.

Docket No. CP73-211

In the preliminary draft of the Natural Gas Survey ___/ the dimensions of the current gas shortage are graphically depicted. The report concludes that not only are significant deposits of gas becoming harder to find. We are mindful however that over the course of the past two years there have been extensive drilling efforts to find new natural gas supplies to meet economic demand. ___/ The report also sets forth the current levels of curtailment and their impact upon the nation's consumers, providing little encouragement that the supply outlook will brighten.

In December, 1974, the Staff issued a report ___/ in which it concluded that "conventional U.S. gas production has reached its peak and will be declining for the indefinite future....(which) means that from hereon we must make do with less gas in absolute terms." ___/ In conjunction with declining production, Staff foresaw increased reliance on supplemental supplies. It is evident that only by encouraging both domestic exploration for natural gas and development of the commercial technology for producing synthetic gaseous fuel can the total gas supply be increased. Therefore in approaching the pricing issue, we feel compelled to review it from a new perspective and to consider our previously enunciated policies as relevant, but not controlling.

We have carefully reviewed our prior decisions on supplemental supply projects. Without exception, we have attached a fixed rate to each certificate authorizing the sale of supplemental supplies. We have reaffirmed this policy on numerous occasions. ___/ In all of these cases, we have refused to adopt the cost of service methodology due to our concern

___/ "The Current Gas Shortage", Chapter 5, Vol. 1, issued June 27, 1974.

___/ "Gas Supply Indicators", OEC Staff Quarterly Report, Third Quarter (1974); "Quarterly Review of Drilling Statistics for the United States," American Petroleum Institute.

___/ A Realistic View of U.S. Natural Gas Supply, Staff Report.

___/ Ibid. p. 20.

___/ Columbia LNG Corporation, et al., 47 FPC 1624 (1972); 48 FPC 723 (1972); Algonquin LNG, Inc., 48 FPC 1216 (1972); El Paso Natural Gas Company, et al., Opinion No. 663 (September 1973); Tecon Gasification Company, et al., Docket Nos. CP72-100, et al., Initial Decision issued August 30, 1973, affirmed February 25, 1974.

Docket No. CP73-211

that the rates might escalate beyond the zone of reasonableness to the detriment of the consumers. Our concern has proven to be real because the costs of supplemental supplies have risen and the Applicants in the foregoing cases have subsequently filed under Section 4 of the Natural Gas Act for increased rates. As we have indicated, the same danger exists in this case.

We find that the CPUC proposal is the most viable method of pricing this new source of supplemental supply for it provides a means of ensuring the Applicants that they will receive a just and reasonable price for the SNG while providing adequate protection for the consumers against imprudent and improper expenses. We therefore find that our certification of this project should be conditioned to provide for an initial rate of \$1.38 per Mcf ___/ which will apply to all SNG which is produced during the first six months of the testing operations. Although we are aware that this initial rate will not allow the Applicants to recover their full costs during the testing period, we further provide herein that all excess cost should be amortized over the life of the project and recovered through the rates subsequently established in a Section 4 proceeding. In so doing, we are providing a means by which the Applicant will recoup all reasonable and prudent costs that are incurred. In the event that the Applicants are unable or unwilling to make a Section 4 filing at the end of the initial six month testing period, they may elect to file for an extension of the \$1.38 rate. In providing for the foregoing, our intention is to keep informed as to the progress of the plant and its operations during the testing period. We believe that this overall pricing mechanism will allow the Applicants to assure their investors that they will recover the costs incurred plus a reasonable rate of return on their investment in this project.

___/ In establishing a rate of \$1.38, we have assumed a Btu content of approximately 970 Btu per cubic feet.

Docket No. CP73-211

During oral argument, counsel for Transwestern Coal Gasification Company introduced the coal supply contract amendment as an exhibit. He asserted the necessity of having the contract amendment as part of the evidence in this proceeding; however, urged us to do so without reopening the record. It was suggested that a motion could be served on all parties and if there should be no answers within the period provided for response, the contract amendment would be accepted into evidence. The Commission approved the proposal. ___/

On March 21, 1975, the Applicants filed a motion to supplement the record with the amendment of March 7, 1975. Western Gasification Agreement No. 1 and a two page tabulation of revised cost estimates as of January, 1975. None of the parties objected to the aforesaid motion and we will therefore allow both exhibits to become part of the record.

The amendment to the coal contract is based on the same concepts as the original contract. It provides for a fixed base price for coal for the life of the contract which escalates in accordance with indices reflecting the cost experience in the coal mining operation. The contract amendment increases the base price from 20.8 cents per million Btu to 26.24 cents per million Btu in addition to modifying various components of the indices.

We have independently reviewed the terms of the contract amendment and conclude that the contractual arrangements are reasonable and in the public interest and that the SNG price may properly reflect all changes in the price of coal which result from the application of the contract formula, with a single exception. Section 7.1 of the amended contract provides that the methods for adjusting the base price may be revised upon the request of either party in the event that "extreme or radical changes in economic factors and conditions from those existing on January 1, 1975," occur "by reason of events or circumstances beyond their reasonable control". It is apparent that this provision will become operative in only highly unusual situations. In approving the March 7, 1975 amendment, we herein reserve the right to review any future modifications to the present contractual provisions that may result from the operation of Section 7.1 and determine whether they are reasonable and in the public interest.

___/ Oral argument, Tr. 1672.

Docket No. CP73-211

We find that the cost of coal as established in the contract amendment should be a component of the initial rate. In determining the amount of the component, we have estimated what price of the coal would have been in mid-1973 under the amended contract. We have found that the original coal component of 24.523 cents per Mcf would have been approximately 30.936 cents per Mcf or 6.423 cents per Mcf more under the provision of the contract as amended. We therefore find that the initial rate should be \$1.38 per Mcf. _/

- (1) Under the original contract, the components of the coal price were these:

	<u>Original Contract</u>
Adjusted Base Price	22.457¢
4% State Tax	.898¢
5% Contingency	<u>1.168¢</u>
	24.523¢

- (2) The base price under the original contract is deducted from the adjusted base price to determine the impact of the escalation provisions. To approximate the impact of the escalation provisions upon the base price of the amended contract, we use the following equation:

$$22.457¢ - 20.8¢ = 1.657¢$$

$$\frac{1.657}{20.8} \times \frac{X}{26.24} = 2.090¢$$

- (3)

	<u>Amended Contract</u>
Base Price	26.240¢
Adjusted Base Price (26.24 + 2.09)	28.330¢
4% State Tax	1.133¢
5% Contingency	<u>1.473¢</u>
	30.936¢

- (4) The differential between the price of the coal under the two contracts is set forth and the appropriate adjustment is made to the initial rate.

30.936¢	\$1.317
<u>-24.523¢</u>	<u>.064</u>
6.423¢	\$1.381

Docket No. CP75-211

During oral argument the Applicants indicated that the cost estimates based on mid-1973 costs submitted during the administrative hearing were no longer realistic estimates of what the price level of SNG would be when full operation of the Wesco plant commences in 1979. Applicants submitted revised cost estimates as of January, 1975 which we have received into evidence in this proceeding. During oral argument counsel for the Applicants asserted that these costs were submitted for the primary purpose of illustrating the effect inflation has had on the original mid-1973 cost estimates submitted during the hearing. Based on this showing of a dramatic increase of the estimated costs over the 18 month period, counsel argued that the Commission should certificate the project without further delay so as to minimize any further increment in costs due to inflation. Counsel for the Applicants did not assert that the revised cost estimates represented a reliable base on which to establish the price level for the SNG, when plant operations commence. The ultimate just and reasonable rate will be prescribed by the Commission based upon evidence presented in a Section 4 proceeding under the Natural Gas Act when the full cost of service of this project is capable of being reduced to reasonable certainty.

In its answer to the Applicants' motion to admit these revised costs and the amended coal contract, Staff did not object to their receipt into evidence. Staff, however, cautioned the Commission that it was essential for the Commission to attach conditions to this certificate which would protect the consumers from excessive cost burdens. In adopting the aforementioned pricing mechanism, we have implemented Staff's pricing proposal, as modified by CPUC, and thereby provided an appropriate means of assuring that the consumer will receive the supplemental supply at the lowest reasonable price.

We are cognizant that the present and future requirements of the Midwestern and California consumers require that we encourage the development of alternate energy supplies. We are also aware that the price level established for these supplies must be compensatory so as to elicit these supplies. However, we are unable to accurately determine at this time what level of pricing would allow the Applicants to recover their full costs plus a reasonable rate of return.

Docket No. CP73-211

We are therefore unable to establish a fixed initial rate for "regular deliveries". By the same token, we are also unable to provide for a full cost of service tariff which would allow us to make only prospective adjustments to the price. Our regulatory responsibilities require us to review the proposed price of the SNG from the Wesco project.

We are concerned about the Applicants' argument that the regulatory lag which accompanies Section 4 filings will jeopardize the financing of the project. In view of the projected shortage for the markets herein involved, which will result from increased levels of firm service curtailments, we can only anticipate that any responsible future Commission would act in an expeditious manner so as to minimize unnecessary delay and thereby preserve the public health and safety and avoid economic hardship.

Incremental Pricing

Although the parties to the proceeding did not consider the issue of how the supplemental supply should be priced to a purchasing distributor, it is an issue which we believe should be addressed in future rate hearings involving both Cities and jurisdictional suppliers of Pacific Lighting. Three-fourths of the project supply will be purchased directly by Pacific Lighting at its incremental price at the California border for delivery solely within the State of California at rates to be approved by CPUC. The question of incremental pricing is therefore not relevant to this portion of the supply which is in fact incrementally priced to the distributor.

Docket No. CP73-211

On the other hand, Cities intends to use this additional supply of 62,500 Mcf per day to offset projected curtailments for its entire system which provides service to various distributors in a five state area. We are foreclosed from considering the issue at this time because it is not part of the record in this case.

We are constrained to put the parties on notice that both the issues of incremental pricing and the protection of purchasers of SNG at the incremental price from the curtailment of supplies so purchased will be considered in subsequent rate and curtailment proceedings, of Cities and the jurisdictional suppliers of Pacific Lighting. ___/ We intend to provide sufficient flexibility for future Commissions to review the allocation of this supplement supply with respect to end use requirements of the customers.

V. Rate of Return

The appropriate rate of return is also an issue in this proceeding. The Applicants urge that a return of 15% on equity is both reasonable and necessary for the project's viability. CPUC and Staff argue that the rate is excessive and should be no higher than 13%. Transwestern's current rate of return on equity permitted by the Commission. They assert that the risk to equity investment does not approach the level of risk assumed by natural gas producers but is comparable to that of pipeline operations.

The rate of return on equity is a function of the relative riskiness of the proposed investment. By adopting the pricing mechanism we have herein with respect to this coal gasification project, we have injected an additional element of risk for prospective investors. Our disallowance of a full cost of service tariff operates as a refusal to guarantee potential investors that they will

___/ Columbia LNG Corporation, et al., 47 FPC 1624 (1972); 48 FPC 723 (1972); 491 F.2d 651 (5th Circuit 1974) remanded an issue of incremental pricing. The remanded administrative hearings have been completed and the proceeding is in the briefing stage.

Docket No. CP73-211

be able to recoup immediately all monies invested, however the adopted pricing mechanism assures them that they will receive a fair return on prudently incurred reasonable costs, subject to protection of the consumer interest for plant production below anticipated levels, as more fully defined below.

We are aware that prospective investors will not view the Wesco project as having an equivalent risk to that of a pipeline. In light of the nature of the project and the importance of its construction, we find that a rate of return on equity of 15% is reasonable and necessary.

VI. Penalty

Under circumstances involving total or partial failure of the plant output, the Presiding Judge attached the following specific condition:

the price is required to be reduced by the amount of any return on the common equity included in the contract price, applicable from and after any period when, for 30 consecutive days, energy production has fallen below 50 percent of the promised supply (250,000 Mcf per day at approximately 970 Btu/cu. ft.) and continuing as long as production so falls short. __/

All the parties to the proceeding agreed that the penalty provision was unfair in that the elimination of return on equity coupled with a fixed unit rate would constitute a double penalty. Both Staff and CPUC suggested alternate penalty provisions based on reductions in the heating value of the gas produced and/or the load factor. Transwestern objects to the imposition of any form of penalty arguing that it is contrary to the concept of "project financing" and thereby endangers the viability of the project. Transwestern also argues that it would penalize Applicants for developments completely beyond their control. In its

__/ Mimeo, p. 43.

Docket No. CP73-211

Brief Opposing Exceptions, Transwestern challenges the proposed level of 970 Btu as being arbitrary and not based on any record showing of the effect of delivery of less than 970 Btu content gas. It is noted that the record is devoid of any evidence concerning the minimum required level of Btu content for pipeline quality gas.

Related to the penalty provisions is the issue of minimum bill. In Opinion No. 622-A, Columbia LNG Corporation, et al., we incorporated a provision which enabled the seller to bill the buyer for all out-of-pocket expenses in the event the seller was unable to deliver any gas for a period exceeding one day. In that proceeding, the Commission also rejected the Applicants' proposed full cost of service tariffs however found that a minimum bill provision was "required by the public convenience and necessity as an equitable apportionment of the risk between customers and stockholders and in order to assure the financing of the project on reasonable terms to the consumer." ___/ Staff has suggested that a similar provision be incorporated in this certificate. **We are aware** however, that the imposition of the foregoing provision would have to be coordinated with the imposition of any form of economic penalty resulting from a reduction in heating value of the SNG produced and/or the **production level so that the magnitude of the latter penalties would not be greater than that under a minimum bill which becomes operative where there is a total failure of deliveries.** If this were not done, the Applicants' incentive to continue deliveries would be reduced.

Due to the experimental nature of the project, it appears premature to establish penalty provisions at this time. In our view, we could more realistically assess the merits of establishing a minimum bill or penalty provision when the testing operations have commenced. At the juncture the Applicants would be able to submit data and reasonable forecasts of the Btu quality and the quantity of SNG to be produced. We would then also be better able to assess what is reasonable in terms of consecutive days without service, **reduced service, and reduction in Btu content.**

___/ Opinion No. 622-A, 48 FPC 723, 730.

Docket No. CP73-211

Staff advocated another proposal on brief which relates to the foregoing discussion. In the event that the plant does not produce its design capacity, 250,000 Mcf per day, or the Applicants are unable to deliver the total quantity of the gas, Staff suggests that Pacific Coal and Trans Coal be required to file curtailment plans with the Commission to provide for the allocation of the remaining production. Transwestern answers that the delivery obligation of the gasification companies are expressed in terms of percentages of output rather than absolute numbers. Thus even if the plant is not operating at design capacity, neither Trans Coal nor Pacific Coal will be in a position where they are unable to deliver the certificated quantity to their customers, i.e., the daily proportionate share of the SNG. We find no merit in the Staff's proposal.

Abandonment

During the proceedings, Staff suggested that there is a danger under Section 7(b) of the Natural Gas Act that the Applicants could abandon deliveries under certain circumstances. In the event that deliveries fall below the design capacity of 250,000 Mcf per day, Staff asserted that Transwestern should be required to seek abandonment authority for its natural gas service. In order to foreclose any possibility of abandonment, Judge Ellis conditioned the grant of the certificate to require the Applicants to execute and file a trust declaration that, to the extent the plant facilities were amortized through receipts from the sale of gas, legal title to such amortized portion would be held in trust for the perpetual use and benefit of California and Midwest consumers.

In its Brief on Exceptions, Transwestern stated its intent not to abandon the facilities or discontinue sales and suggested that the following condition be attached to the certificate in lieu of that proposed in the Initial Decision:

Docket No. CP73-211

Neither Applicants nor any successor or assignee of applicant shall voluntarily abandon the operation of the plant facilities necessary for the sales authorized hereunder or discontinue such sales until such time as the Commission has, after due hearing, found that the continuation of such sales is unwarranted or that the present or future public convenience or necessity permits such abandonment.

The foregoing language tracks Section 7(b) of the Natural Gas Act and provides adequate protection to the consumers. We therefore find that the certificate should be conditioned accordingly.

Pre-empted Capacity

In its Brief on Exceptions, Staff argues that the Applicants' certificates should be conditioned to require the coal gasification companies to pay for any new facilities which might be required as a result of the pre-empted capacity of the pipeline. It is anticipated that the project supply will utilize approximately twenty-five percent of Transwestern's pipeline capacity. Staff's concern is that a new cheaper source of supply might become available to satisfy demand at a price lower than that projected for the coal gas. However, Staff states the following:

But in the absence of evidence that at the time the proposed coal gasification project comes on line there will be domestic production sufficient to eliminate the forecasted shortfall of supply at prices below that of the synthetic gas produced from coal, and in the absence of other less costly alternative (Tr.498), the Commission Staff supports the grant of a certificate as hereinafter conditioned, On this record Applicants' proposal represents the cheapest additional increment of gas currently available to applicants. _/

_/ Initial Brief, p. 8.

Docket No. CP73-211

Staff, in conjunction with the other parties, recognizes the positive benefit that this additional supply will bring to the consumers. Although this supplemental supply will result in more efficient utilization of existing pipeline capacity today, Staff advocates the imposition of a burden on the Applicants' should the domestic energy situation change. We find no merit in this suggestion.

The Commission further finds:

(1) Transwestern Pipe Line Company is a natural gas company subject to the jurisdiction of the Natural Gas Act; and its receipt of coal gas into its line at a point near Gallup, New Mexico, its transportation of mixed natural gas to its terminus at the California border, its delivery of the quantity of mixed gas equal to the coal gas received, are required by the public convenience and necessity.

(2) Transwestern Coal Gasification Company and Pacific Coal Gasification Company will, upon the inception of their respective sales for resale of mixed natural and coal gas become natural gas companies subject to the jurisdiction of the Natural Gas Act as hereinafter set forth; and their sales and deliveries are required by the public convenience and necessity.

(3) The conditions hereto attached are required by the public convenience and necessity.

(4) Transwestern Pipe Line Company's transportation tariffs T-1, T-2 and T-3 are acceptable for filing.

(5) The revised "Comparison of Cost Estimates" admitted in evidence by our order of _____ in this proceeding shall not be a basis of calculation of the initial rate herein established.

Docket No. CP73-211

(6) The initial rate should reflect the change in coal costs established by the Amendment of March 7, 1975, Western Gasification Agreement No. 1, between Utah International and Transwestern Coal Gasification Company and Pacific Coal Gasification Company admitted in evidence by our order of .

(7) The initial decision should be adopted as the decision of the Commission except as modified and supplemented by this Opinion and Order.

The Commission orders:

(A) Certificates are hereby issued to Pacific Coal Gasification Company and Transwestern Coal Gasification Company authorizing them to make the transfers, sales and deliveries, and to build, connect, maintain and operate the facilities proposed and required to effectuate the transfers, sales, deliveries and transportation so authorized.

(1) Pacific Coal Gasification may sell to Pacific Lighting Service Company, at the Arizona-California border near Needles, California, a quantity of mixed natural gas equal to Pacific Coal's delivered share of the coal gas output from the gasification plant proposed to be constructed by the Applicants in New Mexico.

(2) Transwestern Coal Gasification Company may sell to the following:

(a) Pacific Lighting Service Company, at the Arizona-California border near Needles, California, a quantity of mixed natural gas equal to one-half of Transwestern Coal's share of the coal gas output from the gasification plant proposed to be constructed by the Applicants in New Mexico; and

Docket No. CP73-211

(b) Cities Service Gas Company, upon the issuance by this Commission of required authorization. One-half of Transwestern Coal's share of the coal gas output from the gasification plant will be delivered and transferred to Transwestern Pipeline Company, into their main line near Gallup, New Mexico, for the account of Cities. Cities will receive displacement deliveries at existing Transwestern Pipeline delivery points in Harper and Beaver Counties, Oklahoma, and Hemphill County, Texas. The three-party sale to Cities is contingent upon the corresponding final action on Cities' certificate application in Docket No. CP74-185. Should such authorization for any reason not issue or should Cities for any reason not accept any such authorization, then Transwestern Coal is authorized to sell all of its portion of the project gas to Pacific Lighting Service Company.

(3) Transwestern Pipeline Company may --

(a) transport, in its existing pipe lines, from a connection point near Gallup, New Mexico to its delivery point at the California border, a quantity of mixed natural gas equal to the coal gas received from Pacific Coal and Transwestern Coal to the Pacific Lighting Service Company;

(b) transfer and deliver to Cities Service Gas Company, at the existing points of delivery in Texas and Oklahoma, a quantity of natural gas equal in heating value to the quantity of coal gas referred to in sub-paragraph (2) (b) above, all in effectuation of the three-party natural gas sales contracts among Transwestern Coal, Transwestern Pipeline Company and Cities Service Gas Company;

(c) file, place into effect, and charge accordingly its proposed rate schedules T1, T2, and T3; and

Docket No. CP73-211

(d) credit its deliveries pursuant to clauses (2)(a) and (b) against the contract demand authorizations provided in its currently effective service agreements with Pacific Lighting Service Company and Cities Service Gas Company.

(B) The authorizations provided for in paragraph (A) are subject to the following terms and conditions:

(1) Pacific Coal Gasification Company and Transwestern Coal Gasification Company initiating service and sale for resale at a rate of \$1.38 per Mcf during the first six months of the testing period. At or before the end of the six month period, Pacific Coal Gasification Company and Transwestern Coal Gasification Company shall file a revised tariff rate schedule under Section 4 of the Natural Gas Act or request an extension of the initial rate of \$1.38 per Mcf, stating the grounds on which such extension is necessary. Any difference between costs reasonably and prudently incurred and the initial rate of \$1.38 shall be amortized over the remaining life of the contracts.

(2) If a Section 4 filing is not made prior to completion of the testing period it is incumbent upon the Applicants to make such filing within 90 days from the commencement of the first regular delivery in order for the Commission to make a determination of the just and reasonable rate.

(3) Pacific Coal Gasification Company and Transwestern Coal Gasification Company shall neither cause nor permit the transfer or assignment of their respective interests in this project to any other party in which they do not exercise a controlling interest, without prior approval of the Commission.

(4) Notwithstanding any other condition herein attached, in the event of failure of the gasification process, in whole or in part, Pacific Coal Gasification Company and Transwestern Coal Gasification Company shall cause prompt action to be taken by all reasonable means to mitigate any losses and to credit any benefits derived from such actions.

Docket No. CP73-211

(5) Pacific Coal Gasification Company and Transwestern Coal Gasification Company shall, at all times, make available to the Commission their books and records.

(6) Pacific Coal Gasification Company and Transwestern Coal Gasification Company shall not hereafter permit, without prior Commission approval, the further amendment or revision of the coal or synthetic gas sales contracts.

(7) No later than six months prior to the initiation of sales and services authorized herein, Pacific Coal Gasification Company and Transwestern Coal Gasification Company should submit for Commission approval a tariff rate schedule and executed service agreements covering sales and services certificated by Paragraph A, or resulting from such certification.

(C) The authorizations granted herein shall not take effect as to the construction of any facility, or the transportation and sale of any commingled coal gas, until those necessary federal, state and local authorizations for the construction of the coal gasification project have been secured, and a copy of each has been submitted to the Commission.

(D) The general terms and conditions set forth in the Commission's Regulations under the Natural Gas Act and particularly those contained in Parts 154 and 157.20 thereof shall attach to the certificate issued herein.

(E) The facilities authorized herein shall be constructed and placed in actual operation, and the proposed sale and delivery of gas authorized herein shall commence on or before December 31, 1979.

Docket No. CP73-211

(F) The initial decision is adopted as the decision of the Commission as supplemented and modified by this Opinion and Order.

By the Commission.

(S E A L)

Kenneth F. Plumb,
Secretary.

UNITED STATES OF AMERICA
FEDERAL POWER COMMISSION

OPINION NO. 728-A



Transwestern Pipeline Company
Transwestern Coal Gasification Company
Pacific Coal Gasification Company
Western Gasification Company

Docket No. CP73-211

OPINION AND ORDER ON REHEARING

Issued: November 21, 1975

DC-53

UNITED STATES OF AMERICA
FEDERAL POWER COMMISSION

CERTIFICATES; COAL GASIFICATION

Before Commissioners: Richard L. Dunham, Chairman;
William L. Springer, Don S. Smith,
and John H. Holloman III.

Transwestern Pipeline Company)	
Transwestern Coal Gasification Company)	
Pacific Coal Gasification Company)	Docket No. CP73-211
Western Gasification Company)	

Opinion No. 728-A

OPINION AND ORDER ON REHEARING

(Issued November 21, 1975)

SPRINGER, Commissioner:

On April 21, 1975, the Commission issued Opinion No. 728, in the above docket, in which it granted a certificate of public convenience and necessity, authorizing the transportation and sale of coal gas produced by the Transwestern Coal Gasification Project. Applications for rehearing were filed May 21, 1975, by the People of the State of California and the Public Utilities Commission of California (California), Transwestern Coal Gasification Company, et al. (Transwestern or Applicants) and El Paso Natural Gas Company (El Paso). California requested that rehearing be granted for purposes of further consideration thereby allowing California ninety days in which to confer with the other parties and to file any additional pleading. Transwestern supported California's petition however it urged that the time allotted for additional filing be limited to 60 days. On June 2, 1975, the Commission issued an order granting the applications for rehearing and allowed California to make any supplemental filings within 60 days of the order whereupon other parties to the proceeding would be allowed 15 days in which to respond.

After agreement was reached on the major points, on August 7, 1975 California submitted its filing proposing specific amendments to Opinion No. 728. Transwestern and Cities Service Gas Company (Cities), the other principal parties in the proceeding, filed responses which essentially supported California's position. Specifically, California proposed that the initial rate established by the Commission should be increased from \$1.38 to \$2.50 per Mcf; the suspension period

Docket No. CP73-211

should be reduced from five months to one day; a minimum bill should be established whereby Transwestern would be allowed to recoup all costs plus a return on equity of 15 per cent; and, finally the issuance of the certificates should be conditioned upon the Commission reviewing the financing plan for the plant.

The principal parties maintain that if the Commission does not modify Opinion No. 728 as they propose, the project will be abandoned. We have closely reviewed the proposed adjustments in assessing whether these modifications could be implemented without impinging on the consumers' rights. We have attempted to balance the interests of all parties while simultaneously continuing to encourage the development of this facility which would be the first coal gasification plant in the United States. Our review and conclusions thereon follow.

California has recommended that the Commission establish a price of \$2.50 per Mcf for deliveries during the testing period subject to the same conditions set forth in Opinion No. 728. Transwestern maintains that a price of \$2.50 takes into account the 1975 coal contract amendment and revised cost estimates. The foregoing updated costs and contract amendment were submitted to the Commission during oral argument in March, 1975. A procedure was established whereby the Applicants filed a motion to supplement the record on March 21, 1975 to which none of the parties objected thereby allowing the evidence to become part of the record. The Commission then estimated the cost of coal in mid-1973 under the terms of the 1975 contract amendment and in so doing increased the initial rate for the coal gas from \$1.317 to \$1.381.

In establishing the aforementioned rate in Opinion No. 728, the Commission did not rely on the 1975 revised cost estimates but accepted them as illustrating the rapid increase of operating costs. The parties now assert that the costs have risen so dramatically since the filing of the initial application that the proposed price of \$2.50 will not allow them to recover their costs during the testing period but will reduce the amount which must be amortized over the life of the plant and thereby the size of the burden on ratepayers.

We are acutely aware the construction costs of these facilities are rapidly increasing in conjunction with the cost of the feedstock, coal. None of the parties to the proceeding objected during oral argument to the Commission's procedure for allowing these costs to become part of the

Docket No. CP73-211

record. Nor did they respond to the motion dated March 21, 1975 or the pleadings on rehearing. We therefore conclude that the parties to the proceeding have waived their right of cross-examination.

Based on the foregoing, the proposed initial rate of \$2.50 per Mcf is appropriate and in the public interest. We recognize that this price level does not and will not allow the full recoupment of all costs plus a return on equity; however, we have provided a pricing mechanism in Opinion No. 728 which will so provide subsequent to the commencement of plant operations.

California and Transwestern have proposed that the pricing mechanism itself should be modified. Specifically the parties maintain that the Section 4 pricing procedure as established in Opinion No. 728, should include a minimum bill provision and should eliminate the possibility of a five month suspension period. Both adjustments to Opinion No. 728 are asserted to be essential to the financeability of the project.

In Opinion No. 728, the Commission considered the feasibility of establishing a minimum bill provision and concluded that it would be more appropriate to determine its desirability after the plant's testing operations had commenced. Transwestern and Cities assert that the Commission Opinion must set forth a specific minimum bill provision so that the method of recovering monies invested in this project is thereby established. In its filing dated May 21, 1975, Transwestern attached tariff sheets which contained a minimum bill provision which Transwestern maintains is in the form acceptable to the financial community. The proposed minimum bill provision contains the same provisions as the regular tariff and thereby provides for the recoupment of all costs plus a return on equity of 15 per cent. Only in a limited situation would a penalty provision be triggered thereby eliminating the return on equity. The proposed penalty would provide for a zero return on equity in the event that the plant's load factor is reduced to 45 per cent for a period of forty-five consecutive days for all deliveries subsequent to the aforementioned period.

Docket No. CP73-211

We have concluded that we cannot accept the proposed minimum bill provision for it inadequately protects the ratepayers. It would allow the Applicants to bill its customers for all costs plus a return on equity despite a substantial reduction in heating value and/or content of the SNG produced. We are aware however that our rejection of a minimum bill provision would possibly preclude the financing of the plant. Therefore we have reviewed the record and have devised the following minimum bill provision which we find adequately balances the parties' interests.

Transwestern has projected an estimated gas production of 250,000 Mcf per day at an annual load factor of 91 per cent. We believe that a sliding-scale penalty provision, comparable to that set forth by the Presiding Judge in the El Paso proceeding, would more realistically apportion the risks between the ratepayers and the investors. / Therefore, if the plant output should fall below a seventy-five percent load factor, the return on equity and related taxes should be reduced by one third or a level of 10%. If the output should fall below a fifty percent load factor, the return on equity and related taxes should correspondingly be reduced another third or to a level of 5 %. In the event that the output falls below a twenty-five percent load factor, all return on equity and related taxes should be eliminated. Correspondingly, should the heat content of the SNG fall below 950 Btu per cubic foot for a period exceeding 25 days, the return on equity should be proportionately reduced.

Although Transwestern has proposed that return on equity should be eliminated only after a forty-five day period has lapsed, the length of time appears unreasonable. Furthermore the Applicants did not provide any basis for their proposal. We find that a period of twenty-five (25) days would allow sufficient time for the Applicants to repair the facilities yet would allow an added measure of protection for the ratepayers.

____/ El Paso Natural Gas Company, Docket No. CP73-131, issued June 21, 1974.

Docket No. CP73-211

As we have indicated, we are willing to modify Opinion No. 728 so as to assist the financeability of the project if we are able to do so without endangering the public interest. The Applicants state that the suspension period under Section 4 must be limited to one day in conjunction with the establishment of a minimum bill provision so that the timely recovery of costs can be assured. Section 4 allows the Commission the necessary flexibility to vary the length of the suspension period depending on the relevant facts of a particular rate increase. In this proceeding, the Section 4 rate filings will be based upon costs which have been incurred and not upon estimates of costs to be incurred in future periods. As the costs will have been ascertained, it would appear appropriate to reduce the suspension period to one day so that the Applicants should be able to recover all costs reasonably and prudently incurred without experiencing any regulatory lag. The Applicants however will retain their burden of establishing that all costs are reasonable subject to refund. Despite the foregoing, future Commissions may find it in the public interest to suspend for a longer period of time as provided under the Natural Gas Act.

In their filings, Transwestern and California have asserted for the first time that federal assistance in financing this project is essential. They maintain that the project will not be built without federal participation. We are aware that several bills are now before Congress which would authorize the federal government to provide loan guarantees for the construction of coal gasification facilities. California has also urged that the federal government should guarantee the ratepayer that the cost of the SNG will not escalate above a certain level. None of the proposed legislation has been enacted and therefore federal financing is not yet available for Transwestern. As Transwestern has stated that the viability of the project depends on its receipt of this form of aid, over which this Commission has no control, we recognize the probability that this project may be delayed for some period of time. We reserve however the right to review any plan of financing when it has reached final form.

Although both Transwestern and California state that the federal government must assume that portion of the risk which the ratepayers are unable to assume, the amount and form of federal assistance which they seek is not clearly set forth in their filings. Pending the receipt of federal aid, the apportionment of risk cannot be clearly defined. Therefore at the time we review a proposed financing plan, it will be necessary that we re-evaluate the provisions of the minimum bill set forth above.

Docket No. CP73-211

In its filing dated August 25, 1975, Transwestern proposed that the certificates issued herein be further conditioned upon the Commission's review and evaluation of the environmental consequences of the project. Applicants suggest that this Commission should solicit comments from the parties with regard to the Final Environmental Impact Statement published by the Bureau of Reclamation, Department of Interior, to be reviewed by the Commission.

In Opinion No. 728, the Commission outlined its participation in the preparation of the Final Environmental Impact Statement (EIS). The Commission staff addressed solely those areas of FPC jurisdiction and expertise relating to natural gas development, production, transmission and use in comments submitted to the Department of Interior in May, 1975. The Bureau of Reclamation had been designated the lead agency in the environmental review of this project and the Commission did not interpret its role as a major federal action thereby warranting the independent preparation of an environmental impact statement. Furthermore, none of the parties to the proceeding raised any environmental questions.

Despite the foregoing, the Commission will further condition the certificates to provide for an independent assessment of Interior's EIS. We shall therefore provide hereir for a notice to be filed in the Federal Register upon the release of the Final EIS by Interior. Any parties to the proceeding or interested federal, state, and local government agencies may file written comments. The Commission will then review the statement and submitted comments and weigh the environmental consequences.

The Applicants also raised several minor issues. In Ordering Paragraph (D), the Commission imposed on the Applicants the requirement of accepting the certificates within thirty days after Commission action on the application for rehearing. In its filings, Applicants have requested that they not be required to accept the certificates until six months after the issuance of this order, reserving the right to seek an extension of time. Applicants contend that they need the additional time in order to seek the requisite financing and approvals from California. We find the request to be reasonable and concur that the time allotted should be extended.

Docket No. CP73-211

In addition, Applicants have requested that Ordering Paragraph (B)(6) be amended to clearly set forth the Commission's intent to reserve the right to review any future modifications of the coal contract and to determine whether they are reasonable and in the public interest. We shall gladly oblige. In order to clarify any imprecise language, we state herein that the initial rate established does not include the applicable charges for transporting the coal gas from the point of its receipt on Transwestern Pipeline's system to the Pacific Lighting and Cities' delivery points.

The Commission finds:

The grounds for rehearing set forth in the petition filed by the above-named petitioners do not warrant any change in Opinion No. 728 dated April 21, 1975, except as set forth below.

The Commission orders:

The petitions for rehearing of Opinion No. 728 dated April 21, 1975, filed by the above-named petitioners are denied with the exception that

(A) Ordering Paragraph (B)(1) of the Opinion shall be amended increasing the initial rate of \$1.38 per Mcf to \$2.50 per Mcf.

(B) Applicants shall submit within 60 days of this order revised tariffs which provide:

(1) a proportional reduction of return on equity provided in the synthetic gas contract, in the event of failure to deliver gas having a heat content of 950 Btu per cu. ft. for periods in excess of 25 days, as hereinbefore set forth; and

(2) a sliding-scale reduction of return on equity provided in the synthetic gas contract, in the event of failure to maintain deliveries, for periods in excess of 25 days, at load factor levels of at least 75 percent based upon design day operation of 250,000 Mcf per day, as hereinbefore set forth.

Docket No. CP73-211

(C) The authorizations granted herein shall not take effect until the Commission has reviewed the two following documents and determined that such are in the public interest:

- (1) proposed financing plan and
- (2) the Final Environmental Impact Statement prepared by the Department of Interior and the comments thereon.

(D) Ordering Paragraph (D) is hereby amended to allow the Applicants six months from the date of this order to accept the certificates issued herein.

(E) Ordering Paragraph (B)(6) is hereby amended to reserve the right of the Commission to review any future modification of the coal contract and to determine whether such modification is reasonable and in the public interest.

By the Commission

(S E A L)

Kenneth F. Plumb,
Secretary.

UNITED STATES OF AMERICA
FEDERAL POWER COMMISSION



OPINION NO. 763

Natural Gas Pipeline Company of
America

) Docket No. CP75-147

OPINION AND ORDER GRANTING
CERTIFICATION OF TRANSPORTATION
AND SALE OF GAS PRODUCED FROM WASTE

Issued: May 24, 1976

UNITED STATES OF AMERICA
FEDERAL POWER COMMISSION

Natural Gas Pipeline Company of
America

)

Docket No. CP75-147

OPINION NO. 763

APPEARANCES

Paul Mallory for Natural Gas Pipeline Co.

John M. Mee for Thermonetics Inc., & Calorific Recovery Anerobic
Process, Inc.

William Koerner for the Staff of the Federal Power Commission .

UNITED STATES OF AMERICA
FEDERAL POWER COMMISSION

Before Commissioners: Richard L. Dunham, Chairman;
Don S. Smith, John H. Holloman III,
and James G. Watt.

Natural Gas Pipeline Company of) Docket No. CP75-147
America)

OPINION NO. 763

OPINION AND ORDER GRANTING
CERTIFICATION OF TRANSPORTATION
AND SALE OF GAS PRODUCED FROM WASTE

(Issued May 24, 1976)

SMITH, Commissioner:

THE PROPOSED PROJECT

1. This proceeding involves the proposed construction of plant facilities which will convert waste material into methane gas (SNG). Calorific Recovery Anerobic Process, Inc (Calorific) proposes to construct facilities near cattle feed lots in the vicinity of Hooker, Oklahoma. It has entered into a contract with Natural Gas Pipeline Company of America (Natural) whereby it will sell the gas produced at a base price of \$1.33 per Mcf, subject to Btu adjustments and certain escalations, and Natural will reimburse Calorific for any new or additional taxes imposed on the delivery of gas. Natural will take delivery of the gas at the tailgate of the plant and will purchase up to 3,500 Mcf per day, with an option to receive higher volumes, if available.

2. In order to deliver the Calorific SNG into Natural's system, Natural proposes to build approximately six miles of 6-inch gathering pipeline, measuring facilities, and two 500-horsepower compressor units at an estimated total cost of \$930,000. The SNG will not be commingled with natural gas in the gathering system prior to the injection of the gas into Natural's existing transmission facilities. Natural intends to use this new source of SNG to augment overall system supply and not to support any new service.

Docket No. CP75-147

3. A contract between Natural and Calorific was entered into on October 4, 1974, setting forth the above conditions. Should regulatory approval be given in the form satisfactory to both parties, Calorific will then attempt to obtain a plant site and enter into the construction of the project. The term of the foregoing contract is for 25 years.
4. The production of this gas will entail the anaerobic digestion process. Essentially, animal waste is taken from the feed yard and mixed with water which is then subject to a clarification process to increase the concentration of organic solids. The feedstock is then placed in closed tanks called digesters which are sealed to prevent the presence of oxygen. In the digesters, two types of bacteria begin to operate on the feedstock. Acid-forming bacteria work upon organic matter and excrete acid. Methane-forming bacteria function to convert acid to methane gas. The digestion will result in methane gas, carbon dioxide and traces of nitrous oxide and hydrogen sulphide. Solid waste remaining after the operation of the bacteria may be processed to create fertilizer.
5. The basic process of anaerobic digestion is one which has been utilized in municipal waste treatment plants for many years. The most important modifications of the established process by the instant proposal will be in the adjustment and careful control of the environment within the digester. Although the plant designed for Calorific goes beyond present technology, the Applicant and Calorific are confident of its success.

PRICE

6. The base price of \$1.33 per Mcf is subject to adjustments, as defined by three formulas contained in the contract, based on certain indexes published by the Bureau of Labor Statistics. The first formula, with reference to construction escalation, takes into account the wholesale prices of construction, machinery and equipment, and the hourly earnings of contract construction workers. This formula applies proportionately as to 52.63 percent of the \$1.33 base price. The construction escalation formula is operable only once and provides for an adjustment resulting from increases in actual construction costs 14 months after the contract's execution.

Docket No. CP75-147

7. The second formula relates to the operation escalation and takes into account consumer prices. This formula applies proportionately to 40.60 percent of the \$1.33 base price. It is also operable only once, on the day gas is first delivered or is capable of being delivered. Finally, the third formula, also relating to operation escalation, is identical to the second formula except that it takes into account annual delivery volumes. If the volumes delivered during the preceding 12 months exceed 819,802 Mcf, the price decreases proportionately as to 54 cents of the \$1.33 base price. The price does not change as a result of annual deliveries totalling 819,802 Mcf or less. This formula becomes operable on an annual basis commencing 15 months after the date of the initial delivery. In all three formulas, the base indexes used are those for the month of October 1974, the date the contract was executed.

8. Natural's proposal is to treat this new supply on a rolled-in basis with respect to recovering the cost thereof. The impact on Natural's average cost of gas is estimated to about 0.1 cent per Mcf assuming the purchase of 1,000,000 Mcf annually. Calorific will bear the risk and financing burden associated with this project.

9. The base price, estimated construction cost of the facilities and the cost of transportation were unchallenged by the Staff or any of the parties. The Administrative Law Judge meticulously analyzed the cost of this supply, concluding that although the computation was "excessively cautious", a base price of \$1.33 was reasonable and in the public interest. He also approved the rolled-in pricing of the supply.

10. Staff proposed that Natural should be allowed to include a maximum 24 cents per Mcf in its overall cost for the transportation of gas to its transmission system. Upon review, the Judge concluded that the rate was excessive as it was premised on a 60 percent load factor. The Judge determined that 22 cents per Mcf was appropriate based on the Applicant's estimated deliverability of 819,802 Mcf per year.

11. In its brief on exceptions, Staff objected solely to the transportation rate established by the Judge arguing that the initial decision would allow Natural to amortize any transportation costs in excess of the 22 cent per Mcf rate. Staff characterized the Judge's provision as allowing for "open-ended rate treatment" which would place all risks upon the consumers. In its brief on exceptions, Natural made no exception to the Judge's finding. Based on our review we find that the threat of unlimited escalation by Staff appears to be more imaginary than real.

TRACKING

12. It is implicit in the foregoing that when deliveries commence, the contract price will exceed the base price of \$1.33 per Mcf as a result of escalation of factors in the three foregoing formulas. In its initial petition, Natural requested specific authority to pass through increases in the contract price either through its tariff's purchased gas adjustment provision or research and development cost-tracking provision. Staff opposed any form of tracking authorization in the case of artificial gas. In its reply brief filed with the Administrative Law Judge, Natural proposed as a compromise measure that it should be permitted to make effective an initial rate which would reflect the cost in accordance with the agreement and to track such costs for the first 12 months of deliveries. Thereafter, it proposed that any increased cost of the gas will be recoverable through normal Section 4 rate filings by Natural.

13. The Judge found that tracking authorization for changes in the cost of purchasing Calorific's gas and transporting it to Natural's transmission system would not be in the public interest. He therefore provided for Natural to file changes in its rate with the Commission in accordance with Section 4 of the Natural Gas Act with a single exception. Within 15 months of its first receipt of methane from Calorific, he allowed Natural a one-time-only adjustment to flow through changes in its cost of purchased gas. Specifically, he provided that Natural would file a verified statement covering the first 12 months of deliveries which would set forth

Docket No. CP75-147

five specific factors covering monthly and annual volumes received and monies paid for the SNG and cost of transporting SNG. Should such computation result in a cost in excess of the base price plus transportation costs, the Administrative Judge proposed that the difference should be amortized over a period of one year or longer in the pipeline's overall rates at a rate not exceeding .05 cent per Mcf

14. In its brief on exceptions, Natural has characterized its request for a tracking provision to be the principal contested issue. Natural argues that the tracking of the cost of gas is the rule and not the exception. In arguing this point, Natural asserts the public interest mandates the Commission to grant the relief requested by Natural.

15. Natural argues that the Commission should encourage this pilot project because it will contribute to our energy resources, remove a pollution problem, and advance the technology of anaerobic processing. Natural argues further that Calorific bears the risk and financing burden of this plant. The interstate consumer pays only for the gas actually delivered and the price thereof will increase only in accordance with the Consumer Price Index. Natural also asserts that the Calorific plant will enable it to use existing unused pipeline facilities and alleviate existing curtailment to its customers. Natural maintains the price for the Calorific gas compares favorably with that of SNG, LNG, Canadian gas, and gas from the unregulated intrastate market.

16. Natural further argues that unless the PGA clause rate treatment is permitted, Natural is precluded from recovering its costs. It asserts that it would have to absorb the full cost of the gas in excess of average gas cost pending the effective date of a major rate case. It advocates as an additional reason the research and development nature of this project. Natural maintains that the Commission has adopted a policy of encouraging pipelines to invest in research and development and that thereby Natural should be allowed to place into effect rate changes without suspension reflected as research and development expenditures.

17. Natural objects to the procedures established by the Judge whereby it could amortize possible cost increases experienced in the first 15 months of operation. As the price

Docket No. CP75-147

adjustment provisions of the purchase contract do not permit Calorific automatically to flow through all cost increases, Natural argues that the consumers are protected from price increases which would exceed the level expected in light of inflation. Natural asserts that the consumer price index is a "rather stringent ceiling" on price increases for Calorific and that there is no potential for abuse or runaway escalation that would justify denying to Natural full recovery of its costs or require continued monitoring of operating experience.

18. In its brief opposing exceptions, Staff asserts that the Commission has never allowed the automatic recovery of costs through tariff or tracking provisions. Staff further asserts that Calorific bears the significant project risks and that the risks that Natural may bear are de minimis in nature. Staff further finds that Natural's arguments as to delay in recovering costs "illusory" as Natural is not precluded from filing to recover any increases in the cost of the Calorific supply at any time it would deem appropriate.

19. Although Natural maintains that it is essential that it have some form of tracking authorization during the first year of plant operations; we are unable to establish an independent standard for this project. The proposed tracking provision presents an issue which has been before us in many supplemental supply projects. In all of our prior decisions, we have established an initial rate due to our concern that the future rates might escalate to a level which would be detrimental to the consumer. 1/ We recognize that the Applicant and Calorific have attempted to minimize the potential danger to the consumer by providing for an annual adjustment of the price limited to fluctuation of the Consumer Price Index. We cannot however substitute the Consumer Price Index

1/ See, for example, Opinion Nos. 728 and 728-A, Transwestern Coal Gasification, et al., Docket No. CP73-211 (April 21, 1975; November 21, 1975); Opinion Nos. 622 and 622-A, Columbia LNG Corporation, et al., Docket No. CP71-68, et al. (June 28, 1972; October 5, 1972); Opinion Nos. 637 and 637-A, Algonquin SNG, Inc., et al., Docket Nos. CP72-35, et al., December 7, 1972; February 6, 1973.

Docket No. CP75-147

for the performance of our regulatory responsibilities of determining whether a new higher rate is just and reasonable and in the public interest.

20. We are committed to a policy of encouraging the development of supplemental supplies in order to offset the diminishing national gas supply. In order to encourage investors to participate in projects such as the one before us, we are aware that they must be given some assurance that they may recoup their investment and a reasonable return thereon without undue delay. We do not anticipate that our rate review under Section 4 will cause an unconscionable amount of delay in the recovery of the investment proposed herein. In minimizing regulatory lag it is foreseeable that future Commissions will exercise their discretion so as to suspend any proposed rate increases for a period less than five months. This Commission cannot however limit the discretion of future Commissions with regard to the length of the suspension period as proposed by the Presiding Judge. ^{2/}

21. Although the Presiding Judge stated his intention to follow the rate treatment established in Opinion No. 728, Transwestern Coal Gasification Company ^{3/} he made several modifications which are incompatible with the limitations prescribed therein. The proposal to allow Natural to flow through costs which occur during the first 12 months of operation (in its cost of purchased gas) in a one-time-only adjustment is unacceptable. This provision would allow Natural to adjust the initial rate and transportation rate without Commission review. The Commission would be foreclosed from making any adjustments to the rate itself other than prospectively. We specifically disallowed the granting of a certificate of public convenience and necessity without the condition of a specified initial rate in Opinion No. 728. ^{4/}

22. In the instant case, we find that our certification of this project should be conditioned to provide for an initial rate of \$1.33. We are aware that this initial rate may not

^{2/} Initial Decision, mimeo p. 22.

^{3/} See Footnote 1.

^{4/} Atlantic Refinery Co., et al. v. Public Service Commission of N w York, et al., 360 U.S. 378 (1959).

Docket No. CP75-147

allow Natural to recover its full costs during the period of commencing plant operations. We shall therefore provide herein that Natural may make a Section 4 filing after the start up of the plant's operations. All excess costs which are found to be reasonably and prudently incurred prior to the initial Section 4 filing shall be amortized in Natural's overall rates at a rate not exceeding .05 cent per Mcr and recovered through the rates subsequently established in the Section 4 proceeding.

The Commission further finds:

(1) Natural Gas Pipeline Company of America is a natural gas company subject to the jurisdiction of the Natural Gas Act, and its receipt of methane gas into its line near Hooker, Oklahoma, and its transportation and sale of the methane gas are required by the public convenience and necessity.

(2) The conditions hereto attached are required by the public convenience and necessity.

(3) The initial decision should be adopted as the decision of the Commission except as modified and supplemented by this Opinion and Order.

The Commission orders:

(A) Natural Gas Pipeline Company of America is hereby issued a certificate of public convenience and necessity for the interstate transportation and sale of commingled methane gas and natural gas, subject to the following terms and conditions.

(1) No later than six months prior to the commencement of the purchase of the Calorific gas, Natural Gas Pipeline shall file an amendment to its purchased gas adjustment clause contained in its tariff to reflect the costs of methane gas purchased from Calorific at \$1.33 per Mcf.

(2) No later than six months prior to the commencement of the purchase of the Calorific gas, Natural Gas Pipeline shall file an amended tariff to reflect the cost of transporting the methane from Calorific to Natural Gas Pipeline's system at \$.22 per Mcf.

Docket No. CP75-147

(3) Upon the commencement of initial deliveries from Calorific, Natural Gas Pipeline may file a revised tariff schedule under Section 4 of the Natural Gas Act in order for the Commission to make a determination of the just and reasonable rate. Any difference between costs reasonably and prudently incurred and the initial rate of \$1.33 shall be amortized at a rate not exceeding .05 cent per Mcf, over a period of one year or more.

(B) The general terms and conditions set forth in the Commission's Regulations under the Natural Gas Act and particularly those contained in Parts 154 and 157.20 thereof shall attach to the certificate issued herein.

(C) The initial decision is adopted as the decision of the Commission as supplemented and modified by this Opinion and Order.

By the Commission.

Testimony of Fletcher L. Byrom, Chairman of the Board
Koppers Company, Inc., Pittsburgh, Pa.

May 27, 1976

at the

Hearings of the House Subcommittee on Energy and Power
regarding HR Bill 12112

in

Washington, D. C.

My name is Fletcher L. Byrom. I am chairman of the board of Koppers Company, Inc. in Pittsburgh, Pennsylvania. I have been asked to give testimony relating to: (1) the viability of intermediate gas substitution for natural gas; (2) the existing and commercially available technology, and (3) the difficulties involved in high Btu gas generation; as well as the role of coal gasification in solving our immediate and long-term energy problems.

I want to refer you at the beginning to my testimony presented on May 8, 1975 at the Joint Hearings of the Sub-Committees on Financial Markets and Energy of the Senate Committee on Finance. This testimony explores our position on the vital elements of a natural energy policy including tax incentives for energy related projects, and price equalization measures.

Also, on July 14, 1975 we submitted testimony titled: "Coal Gasification: Neglected Response to America's Energy Needs" to the Senate Committee on Interior and Insular Affairs. In it we documented industry's ability to deliver commercial, environmentally safe coal gasification plants which can use any rank of coal.

Background

My company, among other things, is engaged in the engineering and construction field and we are presently capable of engineering, erecting and putting into operation plants which will gasify coal, forming a gas with a heating value of approximately 300 Btu per cubic foot. This medium Btu gas can be used as a synthesis gas to produce certain chemicals for which natural gas is now used, such as ammonia and methanol, and is suitable for consumption by industries requiring heat for their basic processes, or generation of electricity.

Viability of Intermediate Gas Substitution Utilizing Existing Technology

Historically, heavy industry such as electric power generation, steel, chemicals (particularly ammonia for fertilizers), non-ferrous metals, glass and ceramics have been using between one-half and two-thirds of the natural gas consumed in this country. The remainder of the natural gas is consumed by domestic heating, commercial and light industrial uses.

When heavy industry users had their natural gas supply interrupted, in most cases, they turned to fuel oil or liquified petroleum gas (LPG) which has in turn required vastly expanded importation of foreign crude.

Industry needs a new source of domestic fuel immediately. It can be delivered by existing technology. Economic, ecologically sound processes for coal gasification are presently available, and can aid the nation in reaching a measure of energy self-sufficiency.

Introduction of new sources of intermediate gas would reserve available natural gas for domestic heating and light industrial uses where LPG or fuel oils cannot be readily substituted.

Despite any potential increase in new reserves of oil and natural gas, there still exists the eventual depletion of these reserves. We are currently wasting high Btu gas in industrial situations where intermediate Btu gas could easily be used as a substitute. Specifically:

- ... Proven supplies of readily available coal now exist.
- ... Our own Koppers-Totzek process for converting coal to intermediate Btu gas is proven in commercial, large-scale plants in 16 locations outside the United States. Our process has been favorably evaluated by hundreds of industrial companies favoring the substitution of gas from coal for natural gas, from a technical viewpoint.
- ... Industrial facilities - steel plants, glass plants, chemical processing facilities, etc. can, with minor, proven modifications convert from high to intermediate gas.
- ... In geographic areas of heavy industry, a single coal gasification plant could be constructed with sufficient economies of scale to provide an uninterrupted supply of intermediate Btu gas for industry, thereby insuring a continuance of a healthy economy with its resultant effects on employment and industrial growth. This gas could replace the natural gas now being used as fuel gas, and for the production of ammonia and methanol.

Some Difficulties Associated with High Btu Synthetic Natural Gas and Other Processes

Much discussion has centered on the use of coal to produce high Btu gas.

In our opinion the technology is not perfected to provide a full scale commercial

plant that will produce high Btu gas from coal. The answers to many questions involving methanation, control of catalysts and operating second generation gasifiers at high pressures are not yet at hand. Feasibility has been demonstrated, but experience with continuous operations of commercial prototypes is non-existent. Research and development in this area must continue, but this could take approximately ten years to effect a commercial solution to a problem that is here today. On the other hand, we now have technology available to produce medium Btu gas commercially.

There are numerous small, pilot plant gasification plants being funded by the government and/or by industry, which show promise of being successful and could be competitive with the present known technology; but if successful they will not be available to industry on a commercial basis for at least ten to fifteen years. They are not a solution to today's energy problems.

Summary and Recommendations

Commercial coal gasification processes can solve a part of today's energy dilemma, but they must be fitted into a long-term total energy plan.

Government and industry must move immediately to provide intermediate Btu gas as a substitute for natural gas which is currently being used for heavy industry. This would release natural gas which could be used in homes and commercial installations. We can greatly stretch out our natural gas supplies with this concept and insure industrial and economic growth.

It is imperative that the country have a definitive energy policy which will permit early initiation of plant construction. Under present conditions, the

construction of a major coal gasification plant will take in the neighborhood of three years. Even with prompt action¹, we will be several years behind schedule at a time when actual needs will arise.

HR 12112 will provide a part of the solution. Loan guarantees are an important first step, but they are only a preliminary measure. Other funding measures are vitally needed; other government support will be needed.

INCLUSION OF FUSION PROJECTS IN THE
SYNTHETIC FUEL LOAN GUARANTEE
BILL - H.R. 12112

Statement before the House Subcommittee on Energy
and Power by MARILYN ROMANS, Director of Corporate
Planning, Fusion Energy Corporation, Princeton,
New Jersey

May 27, 1976

Ladies and gentlemen, I am in the relatively rare position today of representing the views of a private, totally non-government ~~Fusion~~ research organization. Fusion Energy Corporation of Princeton, New Jersey, is a privately held company, born in 1973. Our financial growth and health to date is an interesting story but it is our future that I am here today to discuss. Fusion projects are not yet included in H.R. 12112. I think this is a mistake.

The Synthetic Fuels Loan Guarantee Plan is, I am told, "not a nuclear bill." And, of course, fusion is a nuclear process. But what is the intent of this bill? If the intent of H.R. 12112 is to bring new energy technology as quickly as possible to the American people, particularly in those areas where private capital sources are reluctant or unable to meet total construction or production needs, then the bill's language should include all components of the energy future which may, within the bill's lifetime, face the problem of project slowdown or extinction due to undercapitalization. Nuclear or non-nuclear, private energy companies face capital problems. This committee wants the fruits of energy invention and technology to find useful implementation as quickly as possible. This is ERDA's mission. It is also Fusion Energy's corporate goal.

New technologies have problems raising capital for two reasons:

1. They are untried and so "high risk."
2. They often require enormous dollar input to reach the turn-over point of making a profit for their investors. New energy sources are often dollar sinks.

In recognizing these problems, the bill's drafters have explicitly included synthetic fuels, solar, wind, geothermal, biomass, and ocean thermal gradient. Why is fusion not mentioned? I have several speculations:

1. This is a non-nuclear bill, as if this were a sacred division. May I remind the committee that solar energy is basically a nuclear energy source. Solar radiation is broad-band spectral radiation, not just the friendly warm infrared spectral slice. Migma Fusion, burning non-radioactive advanced fuels such as deuterium, helium 3, or boron, produces energetic charged particles, collectable as electricity. The sun radiates its energy; Migma Fusion releases its energy to simple electricity.

2. All fusion is identified as government fusion and, therefore, identified with ERDA's feasibility and prototype time-scale. All fusion is thought to be 21st Century business. As one small private corporate voice, let me emphasize to the committee that ALL FUSION IS NOT ERDA FUSION. The small, select community of private fusion research in this country deserves attention to its own needs, apart from ERDA's needs.

Let me remind the panel that almost all major American inventions were made outside large government labs; and with the exception of TV and the transistor, all major American inventions were made outside large corporate labs. Discovery and invention, by definition, take place randomly, often unexpectedly. Discovery has been on our side at Fusion Energy Corporation to date. We have not, and we will not in the near future, seek ERDA research and development grants. ERDA's patent and proprietary data restrictions, liberalized though they have been, preclude us from doing so. We will continue to acquire our R & D capital the time-honored, painful way of knocking on venture capital doors. The 7-year migma fusion program, now in its 2nd year, is funded entirely by the financial community. The goal of the program is an operational prototype fusion power plant using He^3 as fuel, generating 10-100 KW of continuous electric power, a percentage of which will be converted directly to electricity by deceleration in the prototype. This plan uses only commercially available technology, no wild extrapolations. Cost of this migma fusion program is very small compared to that of government-funded fusion projects. FEC's present 5-year plan to develop a 100 KW power source carries a \$63 million price tag, including allowance for inflation. This is in contrast to the new fiscal 1977 ERDA budget requesting \$80 million for one year for one plasma physics lab alone.

FEC is presently negotiating this \$63 million, 5-year investment through a large Wall Street firm. We expect to complete negotiations.

We expect to continue our rapid experimental progress. We expect to light a light bulb via fusion within 5 years. We expect to operate the first 100 MW fusion pilot plant in 1988 at 1¢-6¢/KWH, competitive with present prices. We expect to do all this. Our scientific consultants, some of the most eminent physicists and engineers of the country, see no reason we cannot do this. Our financial backers are taking the start-up risk that we can do this. But from the point of view of this committee, it does not matter whether we WILL do it; it matters that WE MIGHT. And, if the day comes that we are ready to try electric power generation by advanced fuel migma fusion, let me give you an idea of what our capital needs will be and why this bill is important to us:

Our most recent cost estimates, May 1976, show that investments to produce 100 MW standard power plants will rise from 1/2 billion in Year 1 of production to a maximum of \$9.7 billion in Year 6, averaging about \$3 billion per year over the 10 year period required to make a profit on the 500-600 units produced per year. A total investment of \$28 billion will be required to make migma fusion profitable. By that time, if the investors can wait, projected net return will be enormous: \$4.5 billion per year in Year 7. Averaging over a 15 year period we project a yearly net profit of \$1.9 billion or 20% on the maximum investment. A good return for any investor. There is no reason why the U.S. Government, if it participates in the risk through this loan guarantee plan, should not also participate in the return.

I, therefore, urge the committee to reconsider its exclusion of fusion from H.R. 12112. In company with the other environmentally desirable energy sources already mentioned in the bill, Fusion should be explicitly included.

This plan does not guarantee any project will be assisted; it merely sets up mechanisms by which certain projects might be assisted. We at Fusion Energy Corporation think we will have a first product, ready for commercialization in 1982. We think we will need this bill. I hope you will include us.

STATEMENT SUBMITTED TO THE
SUBCOMMITTEE ON ENERGY AND POWER OF THE
INTERSTATE AND FOREIGN COMMERCE COMMITTEE

U.S. HOUSE OF REPRESENTATIVES

Thomas B. Neville
Director, Stanford Western Energy
Policy Study

May 27, 1976

Mr. Chairman and members of the committee:

I am deeply troubled by the tremendous misallocation of resources that is a result of wrong price signals in the energy market. I would prefer to see the system changed so that energy prices reflect the economic and environmental costs of new supplies. However, if changes are not made soon and if gas transmission and distribution companies cannot finance gasification plants then a loan guarantee program may have merit.

The desirability of gasification plants depends on the alternatives to which they are compared. The selection of appropriate alternatives in turn depends on the way the energy market operates. High Btu coal gasification plants appear favorable considering the way the market operates today, but may be less desirable when we compare them with alternatives that are not economic to consumers or producers at current prices.

Today, the energy market is operating very badly because it has separated the suppliers and consumers of energy and because institutional arrangements created by government prevent the appropriate price signals necessary to inform consumers that new energy is very expensive. Consequently, the nation's resources are not being used wisely. For example, some consumers are choosing natural gas heating rather than home insulation because the price of gas is so low; others

cannot get gas and are choosing electricity because it is clean and convenient. At the same time electric utilities on the West Coast are trying to site coal fired plants in the Mountain states in part to move the pollution away from the load centers. If no major changes are made in the system and the situation does not improve dramatically then one of the choices consumers will make is between gas and electricity. During the next decade this choice may boil down to coal gasification plants if other supplies are not forthcoming or coal fired electric generating plants. If this is the choice then gasification plants appear more desirable because on a delivered energy basis they are cleaner, in terms of conventional pollutants, and cheaper.

If the energy market worked perfectly it would be appropriate to carry out an analysis based on all the costs including damage to the environment. In this case the alternatives to gasification plants include increased production of natural gas at market prices, solar water and space heating, and measures to increase energy efficiency such as more insulation. Clearly, solar heating pollutes less than a gasification plant and therefore, if the economic costs are about equal then solar heating may be a better use of our resources. The problem is that some consumers are paying too low a price and others are forced to choose electricity over gas; an analysis based on the full cost of alternatives may produce a misleading conclusion for a

single decision in a very imperfect world. If the problems of the energy market are not improved and consumers are making the gas-electricity choice then government decisions based on a solar vs. gasification analysis may hurt the situation.

There are a number of arguments made for the loan guarantee program proposed in HR 12112: valuable knowledge about commercial operation will be obtained, import dependence will be decreased and gas transmission and distribution companies will find it possible to raise the enormous amounts of capital needed to finance the plants. I find the latter argument most convincing, but these are issues the committee must weigh. I will focus on the economic and environmental aspects of some of the alternatives.

Conventional emissions from coal gasification plants are less than one eighth of those from a coal fired electric plant with a scrubber delivering the same amount of energy. In addition, gasification plants use only one fifth as much water and produce one fourth as much solid waste. (See attachments) Gasification plants produce some toxic and carcinogenic compounds which I understand are similar to those handled in the refining business and though dangerous are manageable. On an environmental basis coal gasification plants appear to be much less offensive than coal fired electric plants. Yet, gasification plants do pollute and solar space and water heating and increased efficiency measures like insulation do not. Despite their importance, knowledge of environment impacts alone is not enough to make a decision - all costs

must be balanced.

Gasification plants cost less than coal fired electric plants on an energy equivalent basis. Plants burning Northern Great Plains coal at the minemouth can generate electricity for about three cents per kilowatt hour or \$9.00 per million Btu. Estimates for gas from a gasification plant range from \$2.61 to \$5.00 per million Btu or more depending in part on the amount of debt and the return on equity. If the choice is between coal gasification plants and coal generating plants, gasification plants appear to be more favorable: they are about eight times cleaner and two or three times cheaper.

The comparison between gasification plants and increased efficiency and solar is less clear cut. We know consumers would use less gas if they were faced with the price of gas from a gasification plant; how much less is unclear. Estimates of the cost of solar water heating have been made by several California utilities, and they suggest that the breakeven price of gas is about \$5.00 delivered to homes or about \$4.30 at a minemouth gasification plant. Solar water heating is more expensive than the low cost estimates for a gasification plant, however, if gasification plants experience cost overruns or if expensive financing is required then solar looks competitive on an economic basis alone. If you add in the environmental impacts solar water heating may look desirable on a total cost basis.

When you think about these questions it is important to ask how the system will work in practice. It would be difficult to design a system which works so strongly against insulation or solar heating as our present one. Water heating and space heating are major components of a residential demand; yet solar cannot compete in this market because low priced natural gas is allocated to high priority residential consumers. In addition California utilities are continuing to hook up new customers.

In contrast, threatened cutoffs of Canadian gas have induced new residential customers in the Pacific Northwest to install electric heating. The price of electricity in the Northwest is low compared to the cost of electricity from new plants because of the large amounts of hydroelectric power. Consequently, the price consumers pay does not reflect the cost of electricity from the new plants because all the costs are averaged together. As a result, about 90% of new homes in representative Northwest service areas are electrically heated; only 32% of existing homes in the Northwest are electrically heated. A major shift in the demand for electricity is just beginning.

The demand for electric power raises serious questions of regional equity. In 1974, 29% of the electric energy for the 11 western states was generated in eight mountain states. As of two years ago utility plans for the following decade placed about 58%, or double that amount, of the new generation

in the eight mountain states. Almost all of these proposed plants were to be minemouth coal plants. In the last two years many of the states and environmentalists have resisted this trend, and it is reasonable to expect the same resistance to gasification plants.

These trends toward extensive coal development in the mountain states are disturbing because they are driven by wrong price signals in a very imperfect energy market. Major improvements in the use of our nation's resources can be made by sending out better price signals. I recognize that there are serious equity problems with many of the needed steps such as natural gas deregulation or taxation of energy and that many of these changes may not be politically possible in the near future. Nevertheless, I believe it is important to try to make the changes. However, if changes are not made and if gas transmission and distribution companies cannot finance gasification plants then a loan guarantee program may have merit in the next few years.

RADIANT CORPORATION

TABLE 3-1
SUMMARY OF ENVIRONMENTAL IMPACT
SNG-FROM-WESTERN COAL

Basis: Production of 10^{12} Btu/day of SNG

Air (lb/hr)	
Particulates	727
SO ₂	1,800
NO _x	7,110
CO	377
HC	115
NH ₃	34.7
Water (lb/hr)	
Suspended Solids	0
Dissolved Solids	0
Organic Material	0
Thermal (Btu/hr)	Negligible
Solid Wastes (tons/day)	5,560
Land Use (acres)	See Section 3.6
Water Requirements (gal/day)	25×10^6
Occupational Health (per year)	
Deaths	1.8
Injuries	61
Man-Days Lost	16,600
Efficiency (%)	
Primary Product Efficiency	68.2
Total Products Efficiency	68.2
Overall Efficiency	68.2

Source: Radian Corporation, A Western Regional Energy Development Study: Primary Environmental Impacts, Prepared for the Council on Environmental Quality & the Federal Energy Administration, EQ4AC037, Aug, 1975

TABLE 3-3

SUMMARY OF ENVIRONMENTAL IMPACTS
POWER PLANT WITH LIMESTONE SCRUBBER

Fuel: Western Coal

Location: West

Module Basis: Production of 10^{12} Btu/day
 equivalent of electrical energy

Air (lb/hr)

Particulates	6,490
SO ₂	13,100
NO _x	89,500
CO	4,970
HC	1,510

Water (lb/hr)

Suspended Solids	0
Dissolved Solids	0
Organic Material	0

Thermal (Btu/hr) negligible

Solid Wastes (tons/day) 20,600

Land Use (acres) 15,900

Water Requirements (gal/day) 131×10^6

Occupational Health (per year)

Deaths	0.35
Injuries	14.6
Man-Days Lost	5,500

Efficiency (%) 35

Ancillary Energy (Btu/day) 0

Source: Radian Corporation, A Western Regional Energy Development Study: Primary Environmental Impacts, Prepared for the Council on Environmental Quality & the Federal Energy Administration, EQ4AC037, Aug, 1975

THE ENVIRONMENTAL ASPECTS OF COAL GASIFICATION *

As we all know, the world faces a very serious shortage of petroleum crude oil. And the Middle Eastern countries have compounded the oil shortage for the industrialized nations of the world by tripling the price of crude oil in the last four years. In the United States, the shortage of domestic crude oil and the high price of imported oil is further compounded by an equally serious dwindling of natural gas supplies.

As a result of this situation, the U.S. energy supply industry has undertaken a wide range of programs to develop clean-burning gas and liquid fuels by the gasification of coal. Why coal? Because the United States has vast reserves of readily available energy in the form of coal. Our total proven recoverable coal reserves contain over 30 times as much energy as all of Saudi Arabia's oil reserves. And the coal reserves which are recoverable with today's mining techniques contain 4 times as much energy as all of Saudi Arabia's oil (see Exhibit 1)⁽¹⁾. Our coal reserves can make us independent of imported energy for at least a hundred years ... and can save us the 20 billion dollars a year we spend on imported oil.

At this time, there are at least six full-scale commercial coal gasification projects under serious design or study in the U.S. They include:

<u>Location</u>	<u>Owner</u>
New Mexico	WESCO (Western Gasification Co.)
New Mexico	EPNG (El Paso Natural Gas)
North Dakota	American Natural Gas
North Dakota	Natural Gas Pipeline Co.
Wyoming	Panhandle Eastern Pipeline Co.
Wyoming	Cities Service Co.

* Presented to the: Interstate and Foreign Commerce Subcommittee on Energy and Power, House of Representatives, Washington, D.C. on May 27, 1976 by Milton R. Beychok (Consulting Engineer) of Irvine, California

All of these plan to use Lurgi coal gasification technology and most of them plan to construct plants in modules producing 250 million standard cubic feet per day (250 MM SCFD) of pipeline quality gas. Four of the projects have filed applications with the Federal Power Commission for approval of their product gas pricing. I have been associated as a consulting environmental engineer with the WESCO project for over three years, and hence most of my comments herein are based upon the WESCO environmental controls. However, I have also provided some consulting services to two of the other projects listed above. To complete this brief background on the status of Lurgi gasification projects, WESCO has obtained a favorable FPC approval and also has operating permit approvals from the New Mexico Environmental Improvement Agency and the New Mexico Surface Mine Commission. The Department of Interior has completed and filed a final Environmental Impact Statement⁽²⁾ with the Council on Environmental Quality. The plant is designed and major equipment specifications are ready for purchase. By all standards, the WESCO project is the most advanced of all the projects listed above.

As an engineer who has spent over 20 years in the design of petroleum refineries, petrochemical plants and gas treating plants in all parts of the world, it is my opinion that the WESCO environmental controls represent the utilization of the very latest and very best available technology. In 1976 dollars, one WESCO plant will cost about 1.1 billion dollars of which 163 million dollars is solely for environmental controls.

CONTROL OF AIR EMISSIONS

Perhaps the most important of the potential emissions from coal gasification is that of sulfur compounds. Since coal gasification is a chemical conversion of coal carbon to methane (the prime constituent of natural gas), most of the sulfur in the coal is chemically converted to gaseous hydrogen sulfide

during the process. This is very much different than the burning of coal which produces gaseous sulfur dioxide. Why? Because we can readily achieve 99% control of hydrogen sulfide, whereas 90% is probably the best sulfur dioxide control we can expect.

Exhibit 2 is a schematic diagram of sulfur emission controls in the WESCO design. As shown, the WESCO gasification plant is designed for 99.3% control of sulfur emissions by a combination of:

- Hydrogen sulfide removal and conversion to byproduct saleable sulfur.
- Incineration of the residual gaseous sulfur compounds to sulfur dioxide, followed by stack gas scrubbing to remove sulfur dioxide.

Since the gasification process requires steam, a utility boiler plant and steam superheater are required. The boiler plant will burn coal to generate steam, and will be equipped with an electrostatic precipitator for removal of fly ash as well as a stack gas scrubber for 90% removal of sulfur dioxide.

Electric power and combustion fuel comprise the major end-use demand for energy in our nation. Coal may be burned to produce electric power or it may be gasified to supply fuel. Since these are alternative uses of the same resource, it is valid to compare the environmental aspects of burning coal in power plants with the gasification of coal. Exhibit 3 very clearly demonstrates that the SO₂ emission controls in the WESCO gasification plant are 10-100 times better than in an equivalent 4,000 megawatt coal-burning power plant. Very few power plants today are yet equipped with stack gas scrubbers. But even if they were and the scrubbers achieved 90% control, the WESCO SO₂ emission controls would be ten times better. This fact is inherent in the fact that gasification converts sulfur to gaseous hydrogen sulfide which can be removed and controlled to 99% whereas the burning of coal produces SO₂ which can only be controlled to 90% at best.

New Mexico is the only State which has yet promulgated point source emission limits specifically for coal gasification plants and their limits are very stringent. (The Federal EPA's standards for coal gasification are not expected to be promulgated until 1977). Exhibit 4 demonstrates that the WESCO design will comply with the New Mexico limits for SO₂ emissions from gasification. Exhibit 4 also demonstrates that the WESCO coal-fired boilers will comply with the New Mexico limits, which are almost four times as stringent as the Federal EPA's limits.

Although not included in Exhibit 4, the WESCO design also complies with New Mexico's limits on nitrogen oxides and particulates, which are again more stringent than the Federal EPA's limits.

IMPACT ON AMBIENT AIR QUALITY

The Environmental Impact Statement (EIS) for the WESCO project, written by the Department of Interior, includes a comprehensive air dispersion study of the entire Four Corners Area based upon the industrial projects which could be present in 1986:

- Four WESCO coal gasification plants
- Three EPNG coal gasification plants
- Four units of San Juan power plant
- Five units of Four Corners power plant

Exhibit 5 summarizes the results of the study which was performed by independent consultants under sub-contract to the Department of Interior. The study concluded, and I quote from the EIS, that "no compliance problems with the New Mexico (ambient air quality) standards would result". As you will note on Exhibit 5, the results are 50% or more below the New Mexico standards, many of which are more stringent than the Federal EPA standards.

It is also worth noting that these results were based on a 'worst possible case' approach and the EIS states that "the meteorological situation which produced the maximum cumulative impact can be expected only about one day per decade".

RESOURCE UTILIZATION EFFICIENCY

Exhibit 6 shows that coal gasification converts about 66% of the thermal energy in the coal into product energy in the form of pipeline gas and byproduct liquid fuels⁽³⁾.

By contrast, as also shown in Exhibit 6, an equivalent coal-burning power plant converts only 35% of the coal energy into product energy.

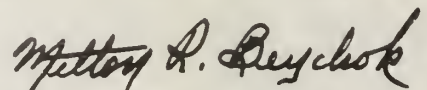
As a consequence of the comparatively low thermal energy efficiency of a coal-burning power plant, it consumes more coal to produce the same amount of energy as does a coal gasification plant. And since a coal-burning power plant rejects 50% of the input energy⁽⁴⁾ to its cooling water system, it consumes more water than does a coal gasification plant. In fact, an equivalent coal-burning power plant uses twice as much coal and five times as much water to produce the same amount of energy as a coal gasification plant (see Exhibit 7).

OTHER ENVIRONMENTAL ASPECTS

There are many other environmental control features of the WESCO project ... not the least of which is that there will be no discharge of wastewater to any surface waterbody. All wastewater will be thoroughly renovated and reused within the plant and mining operations⁽³⁾. And dry air-cooling will be utilized to a maximum extent (rather than conventional water-cooling) so as to minimize the usage of water.

As for other environmental aspects of the WESCO project such as mining area reclamation and revegetation, solid waste disposal, noise controls, etc., I would be pleased to answer your questions.

Thank you for the opportunity to make this presentation before your subcommittee.


Milton R. Beychok

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MILTON R. BEYCHOK

B.S. in Chemical Engineering, Texas A & M, 1946

20 years industrial process design experience with Fluor Engineers & Constructors

Licensed professional engineer in California and Texas

Member of: American Institute of Chemical Engineers
Water Pollution Control Federation
Air Pollution Control Association
American Academy of Environmental Engineers

Government appointments:

Federal EPA, Research Grant Reviewer, 1972
California Regional Water Quality Board, 1973

Government clients:

Federal EPA
National Commission on Water Quality
National Science Foundation
Federal Energy Administration
State of New Mexico

EXHIBIT 1

U. S. Coal can help us become energy independent

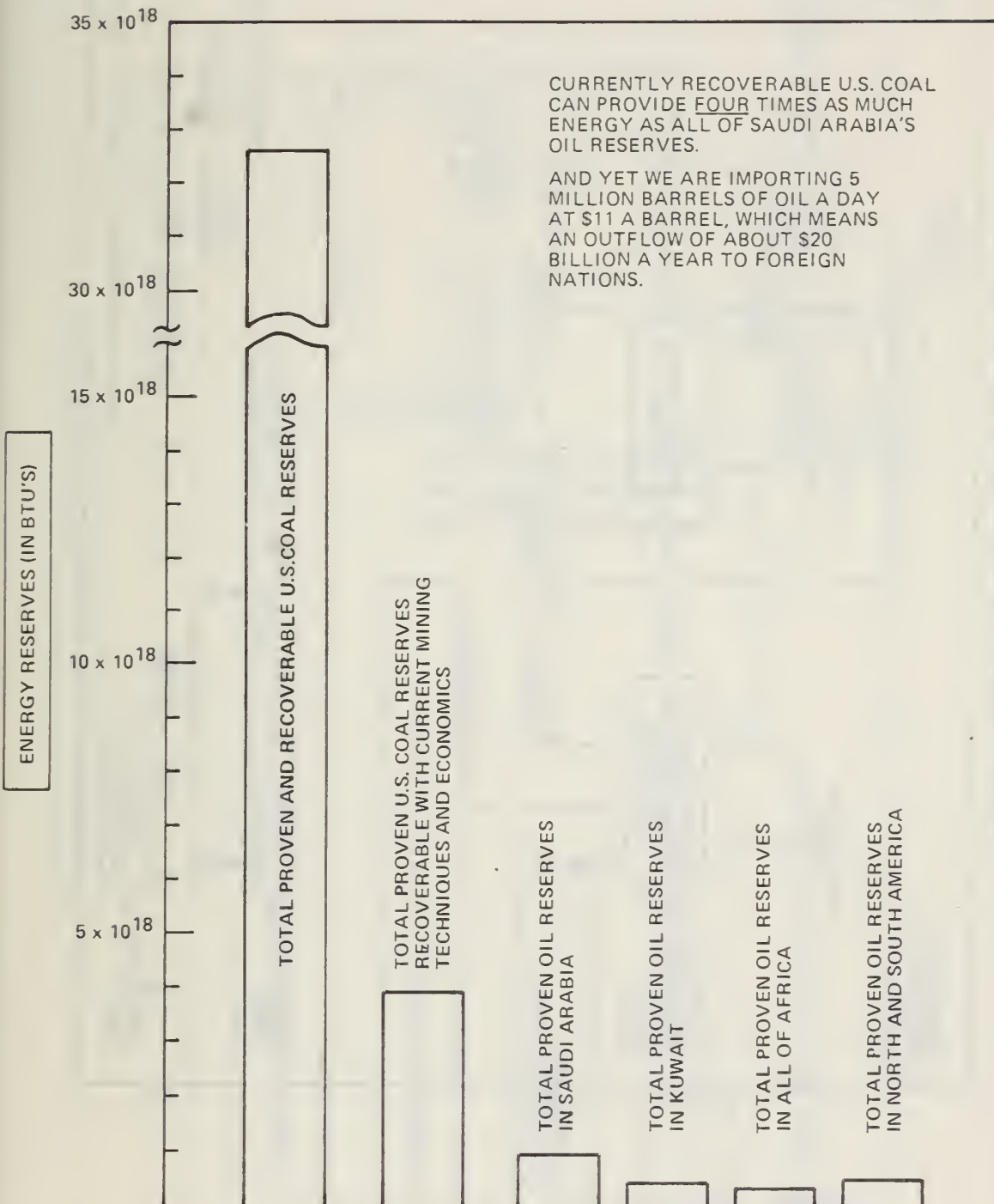


EXHIBIT 2
Coal Gasification Plant designed for 99.3% sulfur control

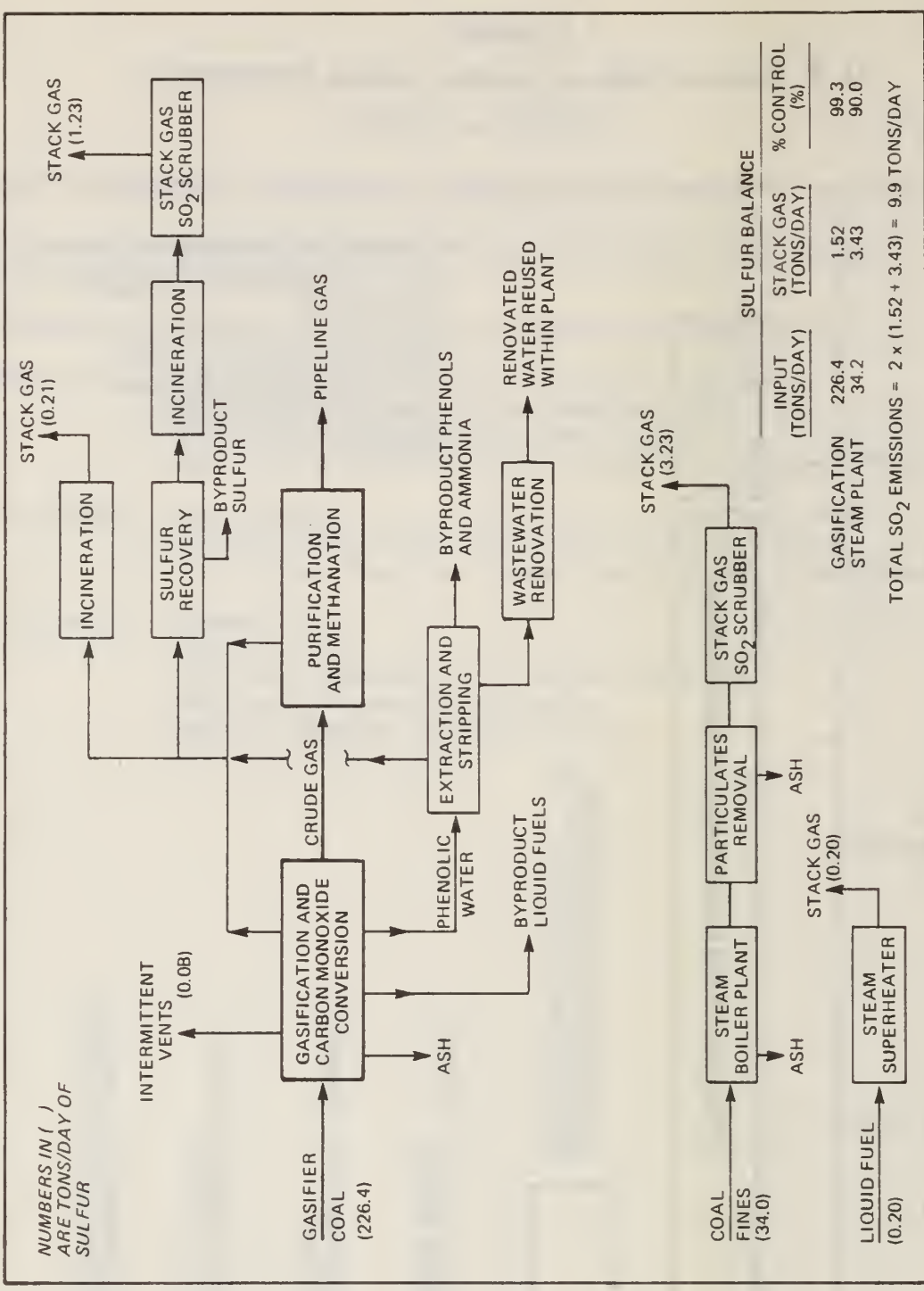


EXHIBIT 3

Gasification SO₂ controls are 10-100 times better than coal-burning power plants

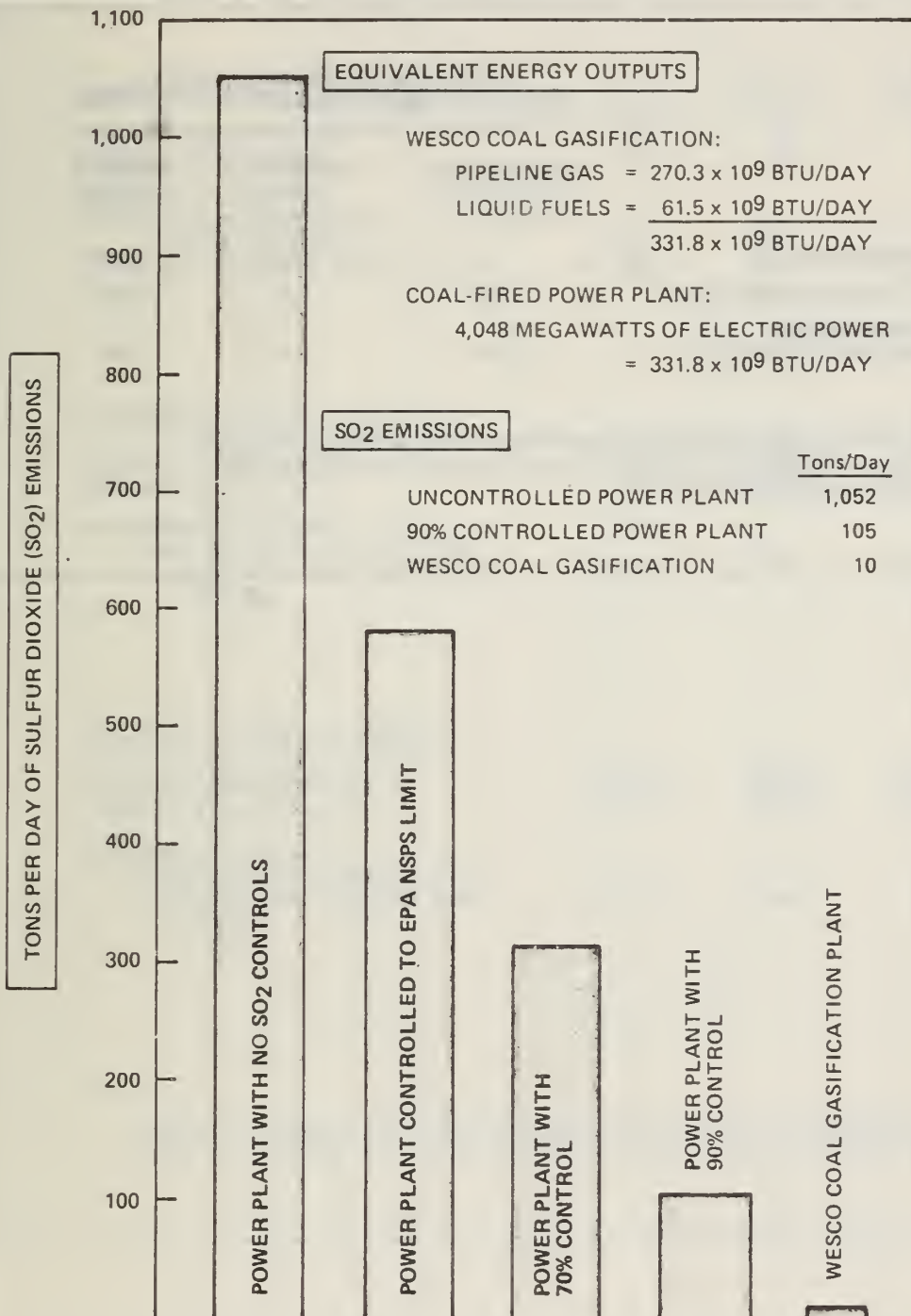


EXHIBIT 4

**Wesco Coal Gasification SO₂ emissions will
comply with stringent New Mexico regulations**

	POINT SOURCE EMISSION LIMITS (POUNDS OF SO ₂ PER MILLION BTU'S OF COAL)		
	FEDERAL EPA NSPS LIMIT	NEW MEXICO LIMIT	WESCO'S DESIGN
GASIFICATION	*	0.016	0.015
COAL-FIRED BOILER PLANT	1.20	0.34	0.17
OIL-FIRED STEAM SUPER-HEATER PLANT	0.80	0.34	0.10
* FEDERAL EPA NEW SOURCE PERFORMANCE STANDARD FOR COAL GASIFICATION IS CURRENTLY UNDER DEVELOPMENT. MAY BE PROMULGATED IN 1977.			

EXHIBIT 5

**Dept. of Interior's Environmental Impact Statement
concludes gasification plants will not violate
Air Quality Standards in New Mexico**

<u>MAXIMUM ANNUAL LIMIT, ug/m³ :</u>	<u>SO₂</u>	<u>NO_x</u>	<u>Partic.</u>
NEW MEXICO STANDARDS	42	77	60
FEDERAL STANDARDS	80	100	60
DISPERSION MODELING:			
WESCO (4 PLANTS)	2-3	4-6	1
EPNG (3 PLANTS)	3-5	3-6	1
POWER PLANTS (9 UNITS)	13-20	21-44	2-3
<u>MAXIMUM 24 - HOUR LIMIT, ug/m³ :</u>			
NEW MEXICO STANDARDS	212	153	150
FEDERAL STANDARDS	365	(NONE)	150
DISPERSION MODELING:			
CUMULATIVE (7 GASIFICATION PLANTS AND 9 POWER PLANT UNITS)	16-39*	3-6*	32-76*
<u>MAXIMUM 3 - HOUR LIMIT, ug/m³ :</u>			
NEW MEXICO STANDARDS	(NONE)	(NONE)	(NONE)
FEDERAL STANDARDS	1300	(NONE)	(NONE)
DISPERSION MODELING:			
CUMULATIVE (7 GASIFICATION PLANTS AND 9 POWER PLANT UNITS)	53-23*	N.A.	N.A.

* BASED ON "WORST CASE" WEATHER CONDITIONS EXPECTED TO OCCUR ONLY 1 DAY PER DECADE, AND RESULTING FROM LINE-UP OF POWER PLANT PLUMES

EXHIBIT 6 **Coal Gasification is twice as efficient as Coal-Fired Power Plant**

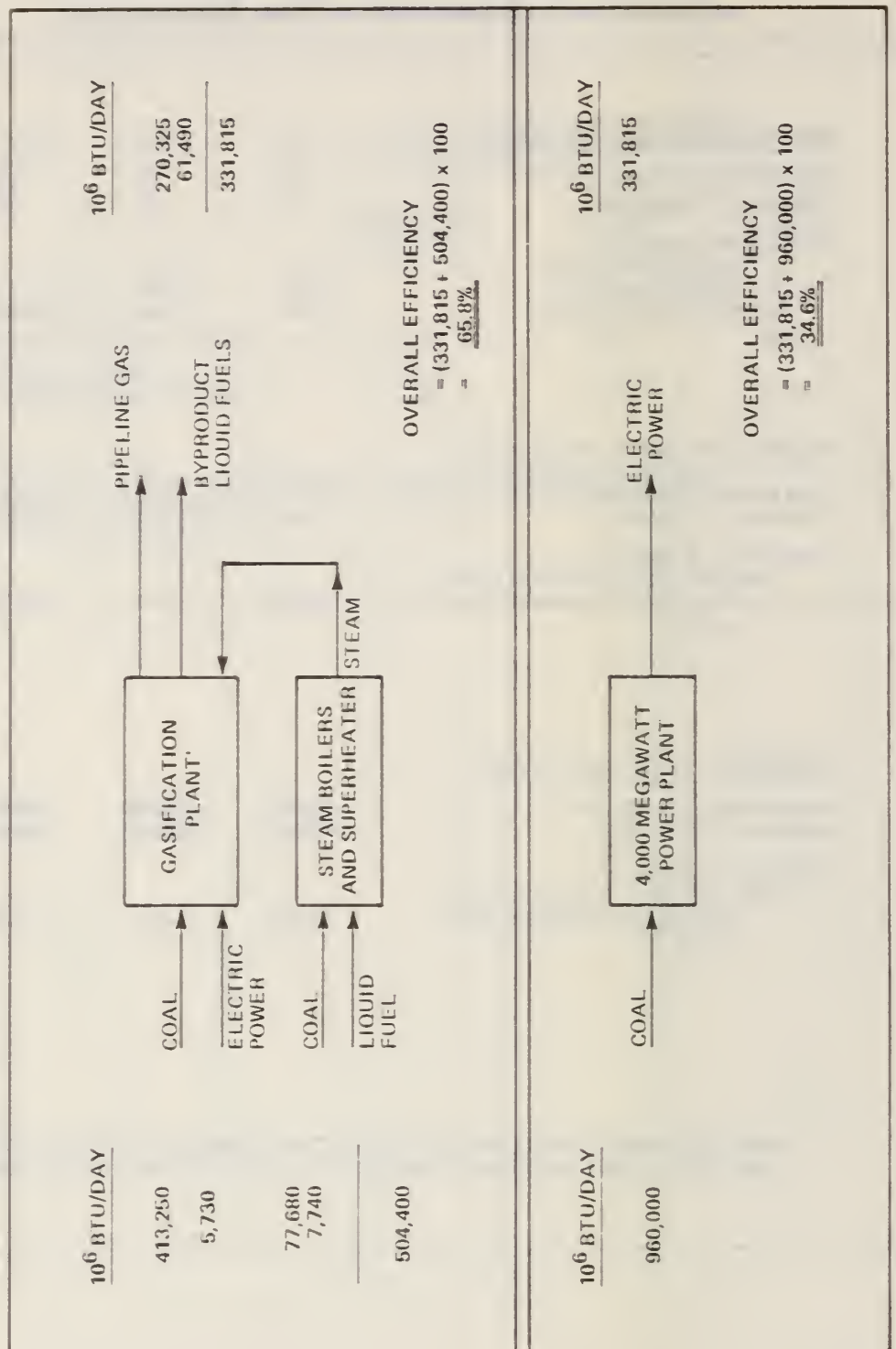
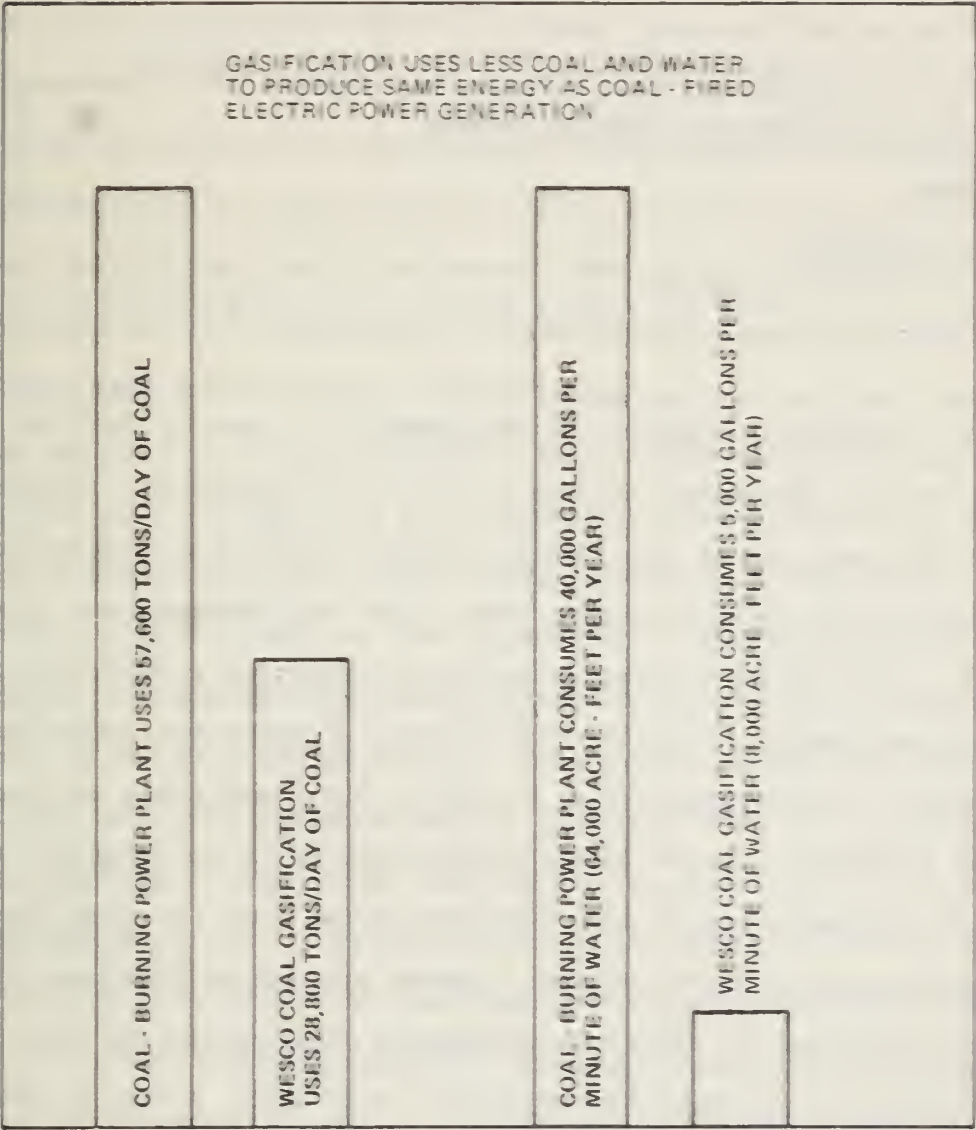


EXHIBIT 7

Gasification uses 1/2 as much coal and 1/5 as much water as does an equivalent coal-burning power plant



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Testimony Before House Interstate And Foreign Commerce Committee

On Synthetic Fuels Commercialization Program

May 27, 1976

By John L. McCormick

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Mr. Chairman, and members of the Committee, I want to thank you for providing me this opportunity to come before you to discuss this legislation. While HR 12112 has come to this Committee under a sequential referral motion, it should have been jointly referred when it was introduced because it most certainly is legislation designed to encourage commercial synthetic fuels ventures using Federal subsidies. The Science and Technology, under the Chairmanship of Representative Olin E. Teague, did a creditable job insofar as providing sufficient time for debate and mark-up but its concerns fell short of some of the most important issues related to the bill. It is my hope that this Committee and the House Banking, Currency and Housing Committee will have time to now focus on those more fundamental problems with the bill.

Before I begin stating my objections to HR 12112, I want to make it clear this Committee that the Environmental Policy Center is a strong supporter of coal utilization either by direct combustion or conversion to a synthetic liquid or gaseous fuel. We realize the great abundance of coal this Nation has; enough to satisfy our needs for centuries. However, we also recognize the serious environmental, social and worker health and safety problems associated with coal mining, processing, transportation and utilization. As this Nation increases its

reliance upon coal, it will not be done as it was done in the past.

Legislation such as the Federal Strip Mine Reclamation bill and amendments to the Clean Air Act, in particular, the significant deterioration provisions of that Act, must be adopted and rigidly enforced. The Coal Mine Health and Safety Act is unworkable and ineffective and must be totally revamped if we are to mine the coal without the sickening cost of human tragedy and suffering. More money must be spent on research and development of safer and more efficient means of mining the coal and finally, the Federal government must reorientate its

priorities and begin channeling the billions of dollars being spent on the Liquid Metal Fast Breeder Reactor Program into solar, conservation, renewable resource, and coal utilization research. Unless these essential tasks are accomplished first, we are going to be faced with a crisis because we will be forced to convert from an oil and gas energy economy to a coal economy before the turn of the century and will not have learned how to use that coal safely and efficiently. The very fact that this legislation is being rushed through the Congress in a few short months while the Federal Coal Leasing bill and the coal strip mining bill are still being debated five years after their introduction is evidence that this Congress still does not have an appreciation of an orderly coal development program. I maintain that, in the absence of a sound coal use policy, we will never have a coal gasification or coal liquefaction industry in this Nation because those regions of the country wherein the coal is found, will fight you every step of the way. It is not that they would harbour those resources, they just want assurance that the Federal government will require development in a manner that offers protection and not colonization.

There are some misconceptions as to the origin of this legislation. Some believe it surfaced from the massive study the President requested when he announced a plan to bring on-line, one million barrels of synthetic fuels by 1985. Actually, the guaranteed loan bill was introduced by Senator Jennings Randolph on July 8, 1975 and it was limited exclusively to the advancement of coal utilization. It was during the Senate Interior Committee mark-up of the E.R.D.A. Authorization bill that the Randolph bill was used as a Christmas tree to hang new programs such as oil shale, solar, geothermal, wind, solid waste conversion technology and finally tacked onto the E.R.D.A. bill. It was not Senator Randolph's intention to create a grab-bag program. That was done at the insistence of other interests who smelled the scent of money and came running. He is one voice in this Congress who consistently calls for greater coal utilization in a responsible manner. While we supported his motive in introducing that bill, we could not support his method.

This legislation has been referred to as the most important energy bill of this Congress. The emotionalism surrounding it makes one believe that it would be unpatriotic to vote against it. That is the problem with trying to legislate in a crisis atmosphere. Clear thinking gives way to a search for quick solutions. But this legislation is not a solution at all. It is a precursor to more legislation of this type. It is the first installment of the President's \$100 billion give-away called the "Energy Independence Authority".

HR. 12112 is not a \$4 billion guaranteed loan program. It is the first Plateau the Congress must reach to qualify it for an additional \$7.1 billion subsidy package when ERDA returns to the hill with more subsidy legislation to insure that a synthetic fuels industry will get off the ground.

One reason a synfuels industry hasn't gotten off the ground yet is simply that the market cannot carry it. The technology is too inefficient and capital intensive and consequently, the cost of the product is too great. But, I am not inferring that we abandon all efforts to advance synthetic fuels technology. On the contrary, I strongly support the existing Research, Development and Demonstration program that ERDA, with the help of legislators such as Chairman Teague, Congressman Hechler, has in place.

The technologies for gasifying coal are varied. Some work most efficiently using bituminous coal while others can only convert subbituminous coal or lignite. Therefore, the choice of a technology may limit its application to only one part of the Nation. The Lurgi coal gasification process achieves the best results when subbituminous or lignite coals are used as the feedstock. These coals are, essentially, non-agglomerating and are found in the coal fields of the Northern Great Plains and the Southwest. Those coals are relatively low in sulfur content and btu value. More important, they are found in some of the most arid and undeveloped regions in the country. Setting up a coal gasification industry around those coal deposits will place an unbearable burden on the scarce water supplies and other resources.

Since the primary purpose of gasifying coal in the first place is to remove the impurities in the coal in order that the energy trapped in the coal can be utilized, it makes good sense to be concentrating on gasifying some of our highest sulfur coal first. The tremendous coal deposits in the Midwest - Ohio, Indiana and Illinois - are medium and high sulfur coals and require either pre-combustion cleanup treatment or pollution control devices after combustion in order to comply with the Clean Air Act provisions. These coals are located close to the existing markets and labor force and, from a National interest standpoint, it makes sense to begin with these coals.

The list of high btu coal gasification technologies that are candidates for guaranteed loans under this program are exclusively Lurgi technology and all would be located in the West and Southwest. Again, these are areas least likely to sustain a coal gasification industry.

Fortunately, there is another office within ERDA with a better idea. The Fossil Energy Division sent out an RFP for a high btu coal gasification proposal on October 3, 1975. To date, five companies have responded. The award of contract is expected in June of this year. The Executive Summary of the RFP states the following: "The Energy Research and Development Administration (ERDA) is herein soliciting proposals for a Pipeline Gas Demonstration Plant Project. This project involves the design, construction, and operation of a coal conversion plant of sufficient size to demonstrate commercial feasibility in the post 1980 time frame." (RFP No.E (49--18)--2012)

The RFP further states that ERDA is interested in reviewing proposals which describe technologies that have applicability to various types of coal including high sulfur (2.5%) and agglomerating coals. This stipulation is to insure that the technology chosen will have the capability of gasifying both eastern bituminous coals and western subbituminous coals. Since the project will be funded on a 50% - 50% cost-sharing basis, all information derived from the project will become a part of the public domain. Therefore, the public's risk is limited and the benefits returned for that risk are far greater.

Contrasting this arrangement with the provisions of HR 12112, we find that the taxpayer's risk of a proposal may be up to 75% of the cost of the total project and there is no access to the technological information derived from that project. The only information which the public derives is the environmental, social and economic impacts and the technological feasibility of the process.

The recipient of the loan puts up 25% of the cost of the project, perfects the engineering, derives hands-on experience, markets the fuel at a price which insures a return on the investment, and retains all information related to the technology itself. All this while assuming 25% of the risk. The public, in a sense, bank-rolls the venture and gets periodic monitoring reports on the impacts.

ERDA spokesmen refer to preferred proposals as those being in the range of 80 million cfpd output or about 1/3 the size of anticipated commercial gasification plants. In their estimation, this scale of demonstration plant will provide the necessary information regarding social, environmental, economic and resource impacts. Most important, the technology must be other than the Lurgi gasification method and the plant must be of a sufficient size to demonstrate commercial feasibility. using a variety of coals.

One contender for a high btu coal gasification guaranteed loan is the American Natural Gas proposal to construct such a plant in North Dakota using the Lurgi gasification method. The original design called for construction of a 250 million cfd plant at a cost of more than \$1.5 billion. Recently, ANG has advised the Wisconsin Public Service Commission of a change in their plans. I would like to quote a paragraph from that memo:

"For several reasons it now appears that the gasification plant would be difficult, if not impossible, to build as initially planned, and as a consequence ANG has decided to construct the plant in two phases. Phased construction will significantly reduce the immense procurement and construction management and control problems necessarily involved in the construction of a plant of the unprecedented size and the complexity of the full Project. Construction of a smaller plant will also significantly reduce the adverse, short-term, socio-economic impact of the Project on the Mercer County community and elsewhere in the State of North Dakota. Strains on the Mercer County school system, for example, will be lessened commensurately with the smaller number of families involved in the construction and operation of a smaller plant. Finally, construction of a full plant the size of that initially proposed appears to present almost insurmountable financing problems, both from the standpoint of raising the equity capital and of obtaining debt financing, with or without Government guarantees."

It is important to note that the size of the plant specified in the new proposal is in the range of the anticipated plant size in the RFP proposal. The logic of the American Natural Gas Company should be commended and heeded.

This legislation is creating parallel tracks within ERDA which will be competing with each other to accomplish the same end. The justification for HR 12112 is that it will provide money to build and operate synthetic fuels plants to determine if they will work and assess the impacts. The traditional RD&D program within ERDA has a similar mission. In the case of the High btu gasification RFP and the ANG proposal to the Wisconsin Commission, the scope of the projects are similar even if the objectives are not.

This bill is redundant and counter-productive to the good effort the Congress has made to giving incentives to new, more efficient synthetic fuels technologies through existing RD&D programs. That approach will insure that all the costs associated with the conversion technology will be represented in the selling price of the product. Only those processes which can prove themselves in the market place will be accepted for commercialization. HR 12112 will cater to those technologies that the market has turned down and will only survive with increasing subsidies.

This Congress will not be acting irresponsibly if it votes down HR 12112. That will be a vote against an energy welfare bill that will only provide the Nation with hardware, not energy.



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TESTIMONY

of

CAROLYN RUTH JOHNSON

on

GUARANTEED LOANS FOR SYNTHETIC FUELS

before the

HOUSE COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE

May 27, 1976

INTRODUCTION

Thank you very much for inviting me here to testify today on proposed legislation to provide \$4 billion for guaranteed loans to the energy industry to finance synthetic fuels development. My name is Carolyn Ruth Johnson, and I am chairman of the Mining Workshop for the Colorado Open Space Council in Denver. In opposing the synthetic fuels loan guarantee program provided in HR 12112, I am today representing the Colorado Mountain Club, Citizens for Colorado Wildlife, Enos Mills Chapter of the Sierra Club, Environmental Action of Colorado, Greeley Audubon Society (Colorado), Greeley Committee on the Environment (Colorado), League of Women Voters of Colorado, Colorado Chapter of Trout Unlimited, PLAN Boulder, Friends of the Earth, National Audubon Society, Denver Audubon Society, National Taxpayers Union (Colorado Chapter), South Dakota Environmental Coalition, New Mexico Central Clearing House, Wilderness Study Project (New Mexico), Council on Utah Resources (representing the Audubon Society, Izaak Walton League, Utah CLEAR, Western River Guides, ISSUE, Save Our Rivers, The Tiger Lilies, Sierra Club, Save Our Canyons, Wasatch Mountain Club, Wasatch White Water Association, Utah Environment Center, Escalante Wilderness Committee, Environment Center of Ogden, Zero Population Growth, Citizens for a Clean Summit County, Utah Nature Study Society, Salt Lake Grotto/National Speleological Society, Ute Alpine Club, and University of Utah Ecology Club.), the Powder River Basin Resource Council (Wyoming), the United Plainsmen (North Dakota), Northern Plains Resource Council of Montana (representing: Stillwater Protective Association, Tri-County Ranchers Association, Rosebud Protective Association, Bull Mountain Landowners Association, McCone Agricultural Protective Association, Central Yellowstone Valley Association, Sarpy Protective Association, and Environmental Information Center.)

a state-wide environmental coordinating council

We all feel that this subsidy program would be a blatant misplacement of money and energy priorities in this country. We believe that sound energy policy must be based on the premise that the true costs of energy production and use should be reflected in the price of that energy. Subsidies to force capital into energy production schemes which on their own merits do not attract free enterprise capital fly in the face of that policy. We think it would be folly to force upon this country large-scale demonstrations of oil shale and coal gasification technologies, where not only would the people have to suffer the impacts of boom towns, polluted air, polluted and depleted water, disturbed land, and destruction of the agricultural base, but also they would end up paying the companies to cause this damage.

It is apparent that the chief goal of this legislation is to assist companies involved in oil shale and synthetics from coal. Although some of the more attractive energy sources are mentioned in the bill, it is unlikely that solar, wind biomass and other renewable energy sources combined will receive more than 20% of the funds. In addition, Dr. Seamans of ERDA was very careful to caution Congress not to expect emphasis on the non-fossil fuels which conceivably could be funded by this legislation. It is also worth pointing out that the Administration tried to remove the non-fossil alternatives from Section 103 last fall, and that elsewhere they have stated that they have ample authority in the solar and geothermal areas. In other words, this legislation is neither formulated properly or indeed needed if it is the non-fossil alternatives that Congress is interested in. The Congressional Budget Office stated:

"... the Administration argues that ERDA already has adequate authority for demonstrating solar and geothermal technologies."

Because the Administration has made its priorities so clear on synthetic fuel development funding, and because it is obvious that the primary lobbying forces behind this bill are the companies who would expect to get guaranteed loan support for coal gasification and oil shale projects, our testimony focuses on the fossil synthetics. Unless the Committee were to rethink and drastically amend this legislation to focus on renewable energy sources, we think it unrealistic to assume that any significant amount of funding would go to anything but oil shale and coal gasification.

HR 12112: Part of a Larger Subsidy Program

Many of our organizations provided information and testimony to the House Science and Technology Committee last fall when Section 103 of the ERDA bill was being discussed. HR 12112 is essentially the same legislation, and as such, our views are essentially the same. Although Section 103 would have authorized \$6 billion for guaranteed loans for synthetic fuels plants and this bill provides \$4 billion, the Administration has stated that they have not changed their view on the ultimate size of the synthetic fuel subsidy program. The Administration is still intending to obtain a \$11.1 billion program of loans, grants, and price supports, as Dr. Seamans testified before the Committee on Science and Technology on March 31:

"...it should be clearly understood that the \$2 billion in loan guaranties provided by HR 12112 would only initiate the program recommended by the Administration. Additional authorizations are included in the President's budget for FY 1977 under the proposed Energy Independence Authority. We remain firmly convinced that in order to achieve the objectives of the full 350,000 barrels per day program, that \$6 billion in loan guaranty authority will be required along with about \$4.5 billion in price guaranty authority and about \$600 million in grants." 3

We do not feel that creating a synthetic fuels subsidy program piecemeal is any better than the whole thing at once. The Congress owes it to itself and the public to consider the full implications of the legislation at hand, including the inevitable pressures for giving the synthetic fuels interests and the Administration what they will "need" to accomplish the program which HR 12112 is designed to begin. HR 12112 cannot be separated from the rest of the proposed synfuels program, for the reasoning which would lead the Congress to pass HR 12112 would inevitably lead you to pass the additional legislation necessary for the program to proceed--the price supports and grants and possible government purchase contracts.

SUBSIDIES DON'T GUARANTEE ENERGY

If the entire \$11.1 billion package is approved, ERDA expects production to reach 350,000 barrels of oil equivalent by 1985. This quantity represents only 1.3% of our 1974 oil and gas consumption. Although it may be attractive to view this program as one that will increase the nation's energy supplies as part of Project Independence, we feel that two important points have been overlooked which should be well understood.

First, not only would this program if successful produce very little energy relative to the dollar investment, but there is no guarantee that it will produce any. It would seem to be an elementary rule of money management--and sound legislation--that if Congress is to guarantee financing for major corporations, in turn, Congress and the taxpayers must receive a firm guarantee that the project will produce. Not only does this bill not include such a guarantee but section 18(g)(3) does not even allow the federal Government to have recourse to the substantial assets of these companies if they default. This would seem to be an invitation to default leaving their assets immune.

Secondly, this program is billed as a testing program to gain information on the technology and its commercialization prospects. It is most important that we keep in mind that tests can go either way--failure or success. We feel that it is very misleading to presume that experimental programs will produce any reliable energy supplies and that it is folly to base any Government policies for increasing energy supply on such a tenuous and experimental program.

BETTER ENERGY BUYS FOR THE MONEY

We strongly believe that, before funding any major programs, Congress should carefully weigh all the possible ways to achieve the desired results at the least possible cost, then it should select those that are the most effective programs for the dollar. We do not believe that in pushing this

this program to Congress, ERDA has made a cost-conscious examination of the alternatives, but Congress has the opportunity to correct this. There are other alternatives, among them are conservation and solar conversion.

ERDA has just released its revised national plan⁴ with a great deal of publicity over the fact that its new top priority is conservation of energy and that the budget for conservation is 60% above last year's. (However, that is 60% of very little--\$75 million to \$120 million.⁵) ERDA selected conservation of energy for all the right reasons: it costs less to save a barrel of oil than it does to produce one through new technology, energy conservation benefits the environment, conservation measures produce continuing benefits, conservation can be implemented faster than new supplies brought in, and capital requirements to increase energy efficiency are lower than capital needs to produce an equivalent amount of energy from new sources "since most new supply technologies are highly capital intensive."⁶ The Federal Energy Administration's work bears up the cost effectiveness of energy conservation with its finding that energy conservation "would save twice as much energy as comparable investment in new supplies would produce."

Other technologies provide for continuous energy savings, while avoiding the tremendous environmental and socio-economic disruptions from synthetic fuels development. For example, if the \$4 billion required by ERDA to fund only initially this synthetic fuel program were invested in solar equipment, it could retrofit about 1,150,000 existing homes and 800,000 new homes, for continuous energy savings.⁸

While ERDA excuses its extremely low level of funding for energy conservation with the undocumented claim that this RD & D function "can better be performed by the private sector" and the bald statement that the "primary responsibility" for energy conservation "rests with the private sector,"⁹ the ERDA plan details at length the woes of the synfuels developers, to back up its desire to provide massive subsidies for oil shale and coal gasification.¹⁰ Frankly, we can't see why it is the Government's responsibility to bail out a few faltering synthetic fuels projects yet someone else's responsibility to pursue the far more promising and beneficial energy alternative. It looks as if the guiding criterion for ERDA energy policy is that the least cost-effective, most technology-intensive energy alternatives should get the most taxpayer dollars. Their proposed synfuel program, of which HR 12112 is a major part, is a good example of this misguided policy.

ENVIRONMENTAL IMPACTS OF SYNFUELS DEVELOPMENT

The environmental problems with synthetic fuels development are confirmed, not disproven, as planning proceeds. Perhaps this can be best illustrated by recent actions on one of the proposed synfuel projects that is most advanced in terms of planning--the C-b federal oil shale tract projects by the Shell Oil and Ashland Oil companies. When the sponsors' detailed mining plan and baseline data--after several years of intensive work--were submitted early this year to the Department of Interior's Oil Shale Environmental Advisory Panel,¹¹

the Panel recommended that the Department not approve the Plan because of the predicted violations of the oil shale lease, State and federal laws in such major areas as water quality and quantity, the leachability of spent shale, air quality, revegetation, and fish and wildlife.¹²

Water

Synfuels presents serious problems with water affecting both quantity and quality. In the West, where water is in very short supply, any major new water use or user is a threat to existing users, including farmers, ranchers, municipalities, wildlife and recreation. This program would intensify already serious water problems associated with energy development in the Colorado River Basin.

Just the anticipation and planning, before subsidies were even proposed, of synthetic fuels development has had serious effects in Colorado; if subsidies are approved and the promise of federal bucks realized, the pressures on and pre-emption of existing water uses, particularly agricultural and wildlife, will increase. The plans that have been laid to date for an oil shale prototype program include at least 28 major water development projects for energy under serious consideration by the U.S. Bureau of Reclamation, in addition to many private projects which have not yet been disclosed to the public.¹³ The end result is that a large number of entities are vying for limited water resources with little or no comprehensive planning or regard for the cumulative end results. The Department of Interior has stated that energy projects planned for the upper Colorado River would consume more water than is available to the states under the Colorado River Compact allocations.¹⁴ Yet, incredibly, the Department has been pushing and accommodating every conceivable energy and water for energy project, in full awareness of the conflicts which will result.

The Bureau of Reclamation's water for energy planning has already substantially pre-empted and disrupted agriculture, which contributes over \$2 billion annually and is the second largest component of the State's economy.¹⁵ Water development projects which were planned to benefit the agricultural community have been changed to go for energy development. As just one example, the Yellow Jacket Project planned for the White River, a major tributary of the Colorado River in the northwest Colorado-northeast Utah oil shale region, was slated originally to have all its 126,400 acre feet for agricultural irrigation. Today, agriculture has been pre-empted by oil shale and coal developers and cut to one-sixth of the planned water--26,400 acre feet. This has also happened on many other large projects such as the San Juan Divide and Dallas Divide.

In the case of water for coal development in the Northern Plains, the Bureau of Reclamation has gone even further in this pattern of disruption and pre-emption of agriculture. Nearly 700,000 acre feet per year have been sold to the major energy companies, many of whom have expressed interest in coal gasification, from reservoir projects authorized and built to serve agricultural purposes.¹⁷ In the Southwest, the Bureau has sold water to Utah International, Inc. for use in the proposed WESCO coal gasification facility on the Navajo Reservation, even though they admit that water shortages in low-flow years will be worsened.¹⁸ In addition, a Library

of Congress Research Service study has concluded that even the Interior Department's calculation of water for coal gasification is based on a gross over-estimation of water¹⁹ in the San Juan River drainage, a major tributary to the Colorado River.

In addition, synthetic fuel interests have already made significant inroads into controlling present agricultural water supplies through purchase of water rights and options and acquisition of farms and ranches. Often these acquisitions are far in excess of estimated uses for synfuels development, leaving open the questions of whether they are speculating on a large scale or that synfuel development would require much more water than has been publicly revealed by the companies.

A good example of this is the actions²⁰ of Gulf Oil and Standard of Indiana in anticipation of their joint venture development of the federal oil shale lease tract in Colorado, tract C-a. They have filed for 300 cfs to be impounded in Yellow Creek Dam and Reservoir, with a capacity of 427,000 acre feet, which the Bureau of Reclamation may sponsor; they have signed an option agreement with the Rocky Mountain Power Co. to obtain a minimum of 45,000 acre feet of water annually; they have obtained or optioned an unpublicized amount of water from private agricultural rights purchased with ranch and farm lands. In addition, these companies have expressed an interest in obtaining 60,000-70,000 acre feet of water from the Bureau of Reclamation's proposed Yellow Jacket Project, which was discussed earlier.

It appears that the federal Government has assumed for itself, without Congressional directive, an obligation to subsidize massive energy development in the West, with heavy emphasis on synthetic fuels, through providing water. The loan guarantee program would amount to an additional, more blatant subsidy to the energy companies.

Water Quality

Mining and processing of coal and oil shale for synthetic coal and oil will adversely affect the quality of the remaining water supplies in the region. Increased sediment loading, chemical and trace element pollution and increased salinity concentrations all would result from synfuels development.

Of concern is the potential for increased salinity in the Colorado River, where there already are severe economic and international problems from excessive salt loading. It is estimated that present damage due to salinity in the Colorado River is approximately \$16 million per year, and that this may rise to \$51 million by 2010.²¹ Each increment of 1 ppm total dissolved solids, which would be caused by every 10,000 acre foot withdrawal,²² will result in an added damage cost of \$230,000 per year.²³ Of course, any increased usage of Colorado River water increases salinity, because less water is available for dilution of salts already present. Energy development in the Colorado Basin will significantly increase salinity because of massive water consumption. In addition, oil shale development poses severe salinity threats which may create problems of a much larger magnitude than water consumption alone. First, the waste shale material is extremely high in soluble salts which could easily end up in surface and ground waters as a result of leaching and erosion, both of which are inevitable given the extremely large quantities of spent shale. Second, oil shale mining in Colorado will require pumping

and disposal of large quantities of saline groundwater for the mining to proceed.²⁴ We have seen no disposal plans which would be certain to avoid salinity hazards from either of these aspects of oil shale development.

Cancer-causing Agents and Toxic Substances

The literature on carcinogenic substances associated with synthetic fuels and their effects on workers²⁵ has been reviewed by the Scientists Institute for Public Information, both historically and in modern times in this country and others. A high incidence of cancer was noted as early as 1876 in the Scottish oil shale industry.²⁶ More recently, abnormally high rates of skin cancer have been noted in workers at the Union Carbide coal liquefaction plant in West Virginia, despite the use of protective clothing.²⁷ The cancer potential is an area which we feel has not received adequate in-depth treatment and study by objective researchers; in fact it is our impression that the companies intimately involved with synthetic fuel technology have been more concerned with pooh-poohing the potential dangers to synthetic fuel workers and consumers than with insuring that those dangers are well known and prevented. In fact, TOSCO officials have attempted to explain away the high incidence of cancer in Scottish oil shale workers as due to their not taking baths.²⁸

Toxic substances, such as arsenic and fluoride, are also of particular concern because of their effects on humans, livestock and wildlife. Recent information from some of the oil shale studies²⁹ indicates that arsenic levels resulting from processing need a great deal more investigation before safety can be assured. In addition, fluoride in the waste waters to be discharged from oil shale mining is predicted to be higher than acceptable standards.³⁰ Part of this water is proposed to be used in reclamation work and suppression of dust-- areas to which both humans and animals (livestock and wildlife) would be exposed.

Boom Towns

The phenomenon of boom towns is extremely well-known in the West-- both historically and at the present. The many problems of rapid population growth in undeveloped areas have been documented thoroughly and can be observed first-hand in such towns as Rock Springs, Wyoming, and Craig, Colorado. The federal Government is well aware of boom town problems, and has described them in numerous reports, including the Project Independence report on oil shale.³¹

In our view, contrary to the views of Dr. Seaman³² expressed before the House Science and Technology Committee, synthetic fuels development need not be subsidized in order to create the anticipated environmental problems so that they can be identified and studied in even more detail. The analysis work done to date predicts enough problems, with enough certainty and expected severity that it would be irresponsible to make a "laboratory" out of parts of the West, in order that the "experiments" can become even more detailed. We are not interested in serving as

guinea pigs, knowing rather well what the problems will be, and knowing even better that "solutions" may not be possible or forthcoming. We strongly feel that solutions should be found for the many existing boom-bust communities and regions, not new areas created. To justify the synfuels program as an experiment in documenting impacts is rather like dropping an atomic bomb on a city merely for the purpose of finding out exactly how many people would be killed or injured. We would hope that the increased interest in and study of the environment in recent years has taught us to pay attention to the predictions we are able to make, however inexact they may be.

Land Disturbance

Coal gasification and oil shale development would both require massive mining operations. In fact, oil shale mines to support 50,000 barrel per day operations would each be larger than any mine in this country at the present time.³³ Thus, an open pit operation would be of staggering proportions, and the land disturbance due to waste disposal even for an underground mine would be enormous. (Because of the small quantity of hydrocarbon in oil shale ore, most of the mined material, 87%, ends up as waste material.) In the West reclamation of any disturbed area is very problematic,³⁴ because of the severe growing conditions, and the problems of reclaiming spent shale are even more difficult than mined land reclamation.³⁵

Wildlife

Impacts on fauna and the flora on which it depends will also be severe. For example, the prime oil shale area of Colorado is also the home of the largest migratory deer herd in the United States.³⁶ All forms of wildlife will be jeopardized by the significant new intrusions of mining, pollution, noise, people and a depleted water supply.³⁷ In addition, rare and endangered species, which are supposed to be protected by law, will be affected by the loss of habitat.³⁸

Rather than go into exhaustive detail in this testimony today on the nature and magnitude of expected impacts, I have appended to my statement a complete analysis of the impacts of oil shale development, prepared by the Institute of Ecology as a critique of the Department of Interior's Environmental Impact Statement on the oil shale leasing program.³⁹

THE "MODULAR" APPROACH

As amended in the House Science and Technology Committee, HR 12112 contains a special provision for oil shale development--75% grants for initial "module" (6-10,000 barrels per day) construction as well as guaranteed loans for commercial-sized plants. (Grants to oil shale are 75% while the Government would provide 50% funding for comparable coal R&D gasification demonstration plants which are one-fourth to one-third commercial scale.) This provision, ironically, gives oil shale preferential treatment, yet it is generally agreed that shale is the least attractive of all the synthetic fuel options. Rather than limiting the subsidies available to oil shale, as some "modular approach" advocates

originally intended, the current version of HR 12112 expands the subsidy commitment. Such a commitment to provide guaranteed loans before the results from the modular test are known and thoroughly evaluated presupposes economic conditions several years away, and would completely remove any incentive for the companies to seek private capital. Without defining criteria for "successful" modular demonstration, the bill offers guaranteed loans to "successful" modular projects--in effect creating "cradle to the grave" subsidies.

The whole discussion of modular development underscores the confusion about the purpose of this legislation: Is it intended to foster additional R & D? Is it intended to launch a "commercial" industry? Or is it intended to bail out corporations who have invested in synthetic fuels? We also find it puzzling that the "modular" approach is being discussed only with reference to oil shale. The same multi-module set-up is characteristic of coal gasification technology. We think that the first question which must be answered on a "modular approach" is what purpose are the modules to serve?

Early, if the modules are to test process technology, then it is unnecessary to construct new and multiple facilities for mining, ore preparation, upgrading, refining and transportation. The modular approach seems to be predicated on the fact that the component of the process most in doubt is the retort itself. Certainly, both oil shale and coal have been mined for decades and the techniques for mining are very well known. Thus, it would be unnecessary to build modules at many different locations--the modules should be located near an existing mine which could be utilized to serve all the technologies under examination, as stated by the Congressional Budget Office:

"Parts of the commercial production are common to many approaches. Large scale coal mining and transportation, materials handling at the plant, waste disposal, and social and environmental impacts are found in all processes which gasify or liquefy coal. There are technical similarities in much of the equipment used in all those processes. Stronger commonalities exist among the approaches to oil shale processing. In both cases differences between approaches are largely in basic chemical engineering technology." 40

Our information indicates that an oil shale module can be constructed, operated, and fully tested for on the order of \$75 million, using existing mining and associated facilities such as those that exist at Anvil Points near Rifle, Colorado.⁴¹ The companies involved have ample resources to bear the cost of that testing and many of them have already made the commitment of sizable sums to buy into a position in the coal gasification or oil shale field, sums far exceeding the costs of testing. For example, Gulf Oil Co. and Standard of Indiana have made a commitment of \$210 million for a federal oil shale lease. It is also obvious that companies have made large investments in developing and purchasing such technologies as the TOSCO II oil shale process and the Lurgi gasification process.

On the one hand, the assumption behind the modular approach seems to be that the companies' uncertainties about investing in synfuels are based on pure technological grounds. On the other, ERDA contends that the technology is well enough known to proceed to commercial scale, risking taxpayers' dollars. The proposal to combine modules now with the prospect of guaranteed loans later seems to confuse rather than clarify the issue. Underlying the whole debate is a contradictory assumption that what is too risky for private investment is safe for the public's money.

We view the modular provision in the bill as nothing more than an exercise disguised as a developmental control. Any commercial-scale oil shale facility will have to begin with a "module" anyway, so the procedure outlined in the bill simply offers the companies money to do what the original guaranteed loan program was supposed to accomplish. The only meaningful "modular approach" would limit the subsidy to the module and provide sufficient criteria and operating requirements to insure that useful information were developed from the project. Yet it is readily apparent that the thrust of HR 12112 is to accomplish commercial-scale production. And, of course, ERDA already has the authority under existing legislation--in the Non-Nuclear Energy Research and Development Act passed in December 1974--to fund a modular program.

FOOTNOTES

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5. Id., p. 37.
6. Id., p. 8.
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13. Colorado Council of Trout Unlimited, testimony before the Subcommittee on Energy R & D and Demonstration (Fossil Fuels), Oct. 27, 1975.
14. U.S. Department of Interior, "Water for Energy in the Upper Colorado River Basin," 1974.
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26. Id.
27. Id.
28. Shale Country, Feb. 1976. (Published in Denver under sponsorship of the oil shale companies.)
29. U.S. Department of Interior Oil Shale Environmental Advisory Panel, Minutes, April 7-8, 1976.
30. Shell and Ashland, Supra.

31. Federal Energy Administration, "Project Independence Blueprint, Final Task Force Report, Potential Future Role of Oil Shale: Prospects and Constraints," Nov. 1974.
32. Seamans, Supra.
33. Approximately 70,000 tons per day of oil shale rock would be mined for a 50,000 barrel per day operation.
34. National Academy of Sciences, "Rehabilitation Potential of Western Coal Lands," 1974.
35. The Institute of Ecology, "A Scientific and Policy Review of the Prototype Oil Shale Leasing Program Final Environmental Impact Statement of the U.S. Department of the Interior," Oct. 29, 1973.
36. Id.
37. U.S. Department of Interior. "Prototype Oil Shale Leasing Program Final Environmental Impact Statement," Sept. 1973.
38. U.S. Department of Interior Oil Shale Environmental Advisory Panel, Minutes, April 7-8, 1976.
39. The Institute of Ecology, Supra.
40. Congressional Budget Office, Supra., p. 33.
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Statement of
GARRY DELOSS
PUBLIC INTEREST RESEARCH GROUP

Before the
SUBCOMMITTEE ON ENERGY AND POWER
of the
COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE
U. S. HOUSE OF REPRESENTATIVES

May 26, 1976

> postponed to May 27

Mr. Chairman and Members of the Committee:

Thank you for the opportunity to comment on H.R. 12112, which would permit ERDA to provide loan guarantees and direct subsidies for the construction of synthetic fuel plants and other projects.

I have been researching and commenting on energy policy for Ralph Nader's Public Interest Research Group since the 1973 oil embargo. We are particularly interested in energy conservation policies. Although we have objected to the price rationing approach of the Nixon and Ford Administrations, whereby proposals to permit artificially high OPEC pricing of domestic oil and natural gas through deregulation were justified partly as conservation measures, we have supported a number of other energy conservation policies.

Earlier this year, for example, we testified in favor of the Energy Conservation Act of 1976, which would provide loan guarantees, interest subsidies, and public education programs to encourage energy efficiency improvements where they would have the most effect--in the vast population of existing homes, commercial buildings and ~~facilities~~ ^{FACTORIES}. Last Thursday and Friday we hosted a national conference on public policies to promote energy efficiency, entitled "Energy Efficiency as a National Priority." At the conference over 20 expert panelists described their experiences in the field of energy efficiency in residential, commercial, and industrial uses and recommended public policy initiatives which would promote energy efficiency.

I have reviewed much of the testimony presented on H.R. 12112 in extensive hearings before the Committee on Science and Technology and the testimony presented yesterday before this committee. I have prepared several brief comments regarding the bill and supporting testimony heard by this committee. In addition, I would like to submit supplementary materials for inclusion in the hearing record.

The first thing you should do in analyzing this bill is to separate the wheat from the chaff. The bill would assure the provision of environmental safeguards to accompany synthetic fuel development and the provision of community impact assistance in areas where the construction of new energy facilities is facilitated by the bill. These are laudable policies but they could and should be adopted regardless of whether synthetic fuels plants are constructed with federal assistance. In other words, these provisions in the bill are irrelevant to deciding whether synthetic fuels development should proceed solely through private funding or with the aid of federal subsidies.

Another provision in the bill that should be irrelevant to your consideration of its merits is the gesture toward assistance for the development of renewable energy sources, including "direct solar, wind, ocean thermal gradients, biomass grown purposefully for recovery of energy values, and wastes of all types, such as urban, industrial, agricultural and forestry wastes." You should note that ERDA assistance to the development of renewable energy sources under this bill is completely discretionary. Therefore it is safe to predict that such assistance would be minimal. If you want to assure assistance to the development of renewable energy sources by this Administration, which is notoriously unsympathetic to such programs, you must mandate their development in separate legislation.

Having discarded the chaff, we can get down to the only useful topic for discussion, which is whether it is desirable for the federal government to provide loan guarantees and other subsidies to encourage investment in synthetic fuel plants. This bill is, in short, a program of capital allocation which is intended to help reduce our need for imported oil. It is an intervention of government in the capital market to provide capital for energy production investments which, we are told, would not be made without such assistance.

Now, let me say at the outset that the best thing about this bill is its history of shrinkage from the \$100 billion Energy Independence Authority version, to the \$6 billion amendment to the ERDA authorization, to the present \$4 billion version. But even the smaller amount of capital allocation must survive a fundamental test. That test is whether this bill would guide investment into the most productive available use in terms of impact on our energy supply and demand.

If we are going to allocate capital in ways that will reduce our need for imported oil, we should create a list of priorities that ranks candidates for investment according to the amount of oil imports that would be displaced per dollar invested. Any capital

allocation program should start at the top of such a list and exhaust the more productive investment opportunities before it moves on to the less productive investments in terms of oil imports displaced per dollar invested.

If such a list of investment opportunities were constructed, it is clear that investments that effectively "produce" energy by improving our efficiency of energy use must be included since the formerly wasted energy becomes available for the same productive uses as newly extracted energy. Unfortunately, but predictably, the Ford Administration has avoided the calculation of energy saved per dollar of energy efficiency investments versus energy produced per dollar of energy supply investments. The Administration's preference for subsidizing the highly centralized energy supply systems preferred by the energy industry regardless of their capital efficiency is exemplified by its proposed Energy Independence Authority, which gives only lip service to energy conservation investments while promising to bail out nuclear power and finance the development of a synthetic fuels industry. The bill being examined here today is smaller in scale, but it shares the EIA's defective preference for energy supply investments.

Although a complete listing of investment opportunities ranked according to their effect on our energy supply and demand is not available, existing evidence suggests that there are many opportunities for investments in energy efficiency improvements that would effectively produce energy at a much lower cost per barrel of oil equivalency than would be produced by investments in the production of synthetic fuels.

FEA Administrator Frank Zarb cited several such examples in testimony before the Joint Economic Committee on February 3, 1976. In the Washington, D.C. area, for example, he calculated that investments in additional ceiling insulation would save energy at a cost of \$5 per barrel of oil equivalency saved. Nationally, investments in storm windows were estimated to save energy at a cost of \$8 to \$13 per barrel of oil saved, depending upon regional climate differences. Examples of energy saving opportunities in industry at a cost of \$11 per barrel of oil saved were also cited by Zarb.

Based on the presentations of panelists at our conference on energy efficiency, I would like to cite a few other opportunities for cost effective investments in energy efficiency improvements:

°Harry A. Tschumi, Jr. of Little Rock, Arkansas, described a superinsulated home design (the "Arkansas Home") which cuts heat loss and gain by 65% over conventional construction with very little additional construction cost.

°Robert Socolow of the Center for Environmental Studies at Princeton University is engaged in a five year study of energy use in a residential development in Twin Rivers, New Jersey. He described a cost effective retrofit project which has reduced natural gas by 25 percent in 16 three-bedroom townhouses. He expects a second round of modifications to cut gas use to only half of the original level.

°Fred S. Dubin of Dubin-Mindell-Bloome Associates described low-cost design features for new commercial buildings which can cut energy use to less than half that required by buildings "constructed in accordance with standards most commonly followed in the past ten years." He also mentioned energy saving modifications of an existing office building that have cut energy use by 29 percent and predicted savings of 50 percent when the program is fully implemented.

°Dallas Sullivan, Energy Conservation Director for Ohio State University, described how OSU has modified campus buildings to cut electricity use by more than one third and natural gas use by about two thirds at a cost which was repaid in only a few months (Appendix I displays the Ohio State University program's success in two tables of data on six campus buildings that have been modified to save energy).

°Robert H. Williams of the Center for Environmental Studies at Princeton University described how electricity could be generated with half the amount of energy required by central power plants when provided instead through factory site installation of facilities for cogeneration of industrial process steam and electricity.

°Finally, Donald Navarre, Vice President for Marketing with the Washington Natural Gas Company in Seattle, described his company's massive success in reducing gas use by promoting energy conservation. Surveys disclosed that the gas company's attic insulation program alone reduced gas use by 23 percent. The cost effectiveness of the attic insulation investment is so good that gas customers who pay the gas company for the reinsulation work through payments on their monthly gas bills often pay smaller net monthly payments to the gas company than they paid prior to insulating. The combined use of attic insulation, a pilotless gas furnace, and an automatic night setback thermostat was found to cut gas use for heating by 37 percent. Further savings are available through a "conservationist gas water heater" which uses 25 percent less energy than alternative water heaters.

I have cited these examples of cost effective investments in improved energy efficiency to emphasize the potential for effectively increasing domestic energy production through investments which would free presently wasted energy for productive uses. As Donald Navarre of the Washington Natural Gas Company observed in regard to the gas savings created by his company's marketing of energy saving goods and services,

"We suddenly realized we had been sitting atop a new gas field for years and didn't recognize it. As an example, the now-insulated homeowners are saving about 744 million cubic feet of natural gas each year simply because of proper attic insulation. Putting it another way, we can now supply gas to about another 8,000 insulated homes without the necessity of any increased gas supply."

These and other experiences described by the panelists at our conference add up to a strong argument in favor of the Energy Conservation Act, which would guide investments into energy efficiency improvements, and against H.R. 12112, which would guide investments into synthetic fuel plants. The energy efficiency investments would not only produce more energy per dollar invested; they would also avoid the environmental disruption of expanding the energy extraction industry, provide more and better distributed job opportunities, and reduce oil imports sooner than possible through investments in synthetic fuel development. Given these advantages, we should spend the next 15 years "drilling" and "mining" new energy supplies in buildings and factories in all 50 states rather than tearing up our mountain states and the northern great plains for a few barrels of synthetic fuel. Thus the American Institute of Architects has calculated that investments in improving the energy efficiency of new and existing buildings sufficient to save 12 million barrels of oil per day by 1990 would be a much more productive use of scarce capital than investments in traditional centralized energy supply systems during the same period.

The Administration's policy of favoring energy supply over energy efficiency, as represented by the proposed EIA and by H.R. 12112, is a policy of less bang for the buck. It may please the energy industry but it is not in the national interest. In fact, H.R. 12112's diversion of investments into energy supply options such as synthetic fuels would actually increase our need for imported oil rather than decrease it. This would occur because more energy can be produced from guiding the \$4 billion of capital into energy efficiency improvements. The loss in capital efficiency represented by investments in synthetic fuels would have to be made up by importing more oil.

The Administration response to this analysis is predictable. They will concede the short term capital inefficiency of investments in synthetic fuel development but ^{that} argue/federal aid is needed to encourage the long term development of synthetic fuels. My reply is that there are long term opportunities for improvements in energy efficiency technology which will very likely continue to maintain the Btu per dollar advantage of energy efficiency investments over investments in marginal energy supply options such as some synthetic fuels and nuclear power. The American Physical Society's 1974 Summer Study is a good source of suggestions for energy efficiency research priorities. When you know that the average home heating system has a "second law efficiency" of only 5 percent, for example, you can see that theoretically there is room for a 20-fold improvement in efficiency. While perfect efficiency is not a viable goal, the efficiency

Page Six

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of home heating systems might be increased several fold in the years ahead. Similar improvements are possible for other energy using systems over the long term.

In summary, I recommend that the committee reject H.R. 12112 and instead focus on the Energy Conservation Act of 1976, which I understand will be the subject of joint hearings by this committee and the Banking Committee. Since those hearings will examine the Energy Conservation Act and the EIA proposal simultaneously, the capital allocation issues which I have raised here today will be relevant at that time as well. I would like to close with the recommendation that when you hold those hearings, you should solicit the testimony of some of the persons whose work I have mentioned here today.

Thank you.

APPENDIX I

TABLE 1. ENERGY CONSUMPTION REDUCTION IN OHIO STATE UNIVERSITY BUILDINGS

<u>Building</u>	<u>Electricity Reduction (%)</u>	<u>Natural Gas Reduction (%)</u>	<u>Months Monitored</u>
Allied Medical	43	78	12
McC Campbell Hall	63	72	12
Health Sc. Library	20	76	6
Electronics Lab	48	31	6
Biological Sciences	19	49	6
Howlett Hall	24	60	6
Average Reduction	36	61	

The dollar savings derived from the energy savings are so great that payback periods for the modification costs, displayed in Table 2, are exceptionally brief, ranging from 4.5 months to 11.6 months,

TABLE 2. DOLLAR SAVINGS IN THE OHIO STATE UNIVERSITY ENERGY CONSERVATION PROGRAM

<u>Building</u>	<u>One-Time Modification Cost</u>	<u>*Achieved Savings of Electricity and Natural Gas</u>	<u>Payback Period</u>	<u>Months Monitored</u>
Allied Medical	\$30,000	\$59,221	6 months	12
McC Campbell Hall	57,200	53,551	13 months	12
Health Sc. Library	27,500	42,971	8 months	6
Electronics Lab	25,750	26,385	11.6 months	6
Biological Sciences	37,156	99,424	4.5 months	6
Howlett Hall	31,738	57,386	6.5 months	6
Total	\$209,344	\$338,938	7.4 months	

*Based on monitored energy use over the period shown and projected to total yearly saving at current utility rates.

The dollar savings displayed in Table 2 would be even greater, and the payback periods much shorter, if the savings were calculated for oil as the heat source rather than natural gas.

Testimony by

THOMAS P. SALMON

Governor of Vermont

Chairman

Natural Resource and Environmental Management Committee of the

National Governors' Conference

before

House Science and Technology
Committee

April 6, 1976

I appear before you today in my capacity as Chairman of the National Governors' Conference Committee on Natural Resources and Environmental Management. As many of you recall, a number of my colleagues and I testified before this Committee's Fossil Fuels Subcommittee last October, with respect to key provisions necessary for a successful synthetic fuels program. Although we are here again to address many of the same provisions, I would be remiss if I did not commend this Committee for incorporating a number of our most important concerns in H.R. 12112. The proposed Synthetic Fuels Demonstration Bill we have before us today is a far cry from the legislative proposal that we considered late last fall.

Mr. Chairman, I sense that the character of this Committee is one of integrity and understanding. You have all labored over a massive proposal by the Administration that purports to move this country closer to Energy Independence. None of us doubt that we should strive toward the attainment of such a goal; however, the means to that end often differs with ones individual philosophy of government's proper role in the entire energy situation.

The Nation's Governors are committed to a National Energy Policy and program that is comprehensive in scope. Such a policy and program must address itself to a wide variety of energy development and conservation alternatives. The Governors of this country have called such efforts on numerous occasions, and stand ready to assist the Congress and Administration in their efforts to develop the long range plans that are necessary to achieve that goal.

The National Governors' Conference has reviewed the proposed synthetic fuels program with great care and interest. A task force has been created under the auspices of the NGC Committee which I chair, and is led by Governor Richard D. Lamm of Colorado. Other distinguished Governors on the task force include two former Chairmen of the National Governors' Conference, Governor Arch A. Moore, Jr. of West Virginia, and Governor Daniel J. Evans of Washington. They are also joined by Governor Julian M. Carroll of Kentucky, Governor Ed Herschler of Wyoming, and Governor Arthur A. Link of North Dakota.

The task force has examined a wide variety of issues concerning ERDA's synfuels proposals. The magnitude of the program would have a great impact on a number of our states. As a result, we firmly believe that the decision to proceed with the program should only come after full debate on impacts that the program may produce - both positive and negative. As Governor Lamm pointed out last October, "The decision which Congress makes on synthetic fuels would have a massive effect on all our states. In some states, it could prove to be the most important piece of federal legislation in two centuries."

We are entering a phase in our country's energy future which must be approached not only with great caution, but with even greater foresight and determination. If this or any other large scale proposal is to work, we must assure at a minimum that the communities that must host energy facilities can, and will, survive as viable communities. As public officials, each of us can settle for nothing less. In the final analysis, this must be an overriding concern.

The proposal before us today calls for the need to demonstrate the commercial feasibility of producing synthetic fuels from coal, oil shale, and to employ other energy resources and forms of energy. Energy conservation demonstration is also

included in the program. Available program dollars can only be allocated to a limited number of these areas at this time. However, this does not lessen the role conservation can play in our overall strategy. Should the program be authorized, it is imperative that the Congress insist on demonstrating conservations commercially feasible role before the program moves very far ahead.

The need and desirability of demonstrating the commercial feasibility of producing synthetic gas and petroleum is essential as our domestic production of fuel declines. We are all aware of the growing dependence on imported foreign oil. This February, for the first time in our nation's history, we imported more oil than we produced. Continued movement in this direction without corrective steps, could cause disastrous balance of payment and national security problems. We must supplement our dwindling domestic natural gas and petroleum production.

As holders of 25% of the world's coal reserves, a program to foster its wise and environmentally acceptable use is a long overdue national priority. Much of the emphasis of the proposed synfuels program addresses the utilization of various domestic coals for high and low BTU gas demonstration facilities, and at a later stage, conversion processes that liquefy coal are to be incorporated into the demonstration program. Should these processes prove to be commercially feasible, significant additions may be added to our domestic energy supply of natural gas and petroleum.

As indicated earlier, I believe that H.R. 12112 has been strengthened by the addition of several provisions which address the question of amelioration of adverse socio/economic impacts. The mere recognition that these concerns were addressed can only bolster the point that any adverse impacts experienced by our communities must be eliminated if this proposed program is to succeed.

In this regard, the NGC Synthetic Fuels Task Force has recommended that a number of key elements become part of any synfuels demonstration program. These recommendations have been approved by the NGC Committee on Natural Resources and Environmental Management, and are offered for your consideration as follows:

Task Force Recommendation #1

"All synthetic fuels demonstration and development projects receiving Federal loan guarantees should be made subject to state laws and regulations regarding health, land use, land reclamation, water rights, and taxation."

Section 17(u) indicates that a borrower who receives a guarantee under this program shall comply with Federal and State environmental, land use, water, and health and safety laws, and to obtain applicable Federal and State permits, licences and certificates. It is the strong recommendation of the Task Force that state laws regarding reclamation and facility siting be applied to synfuel projects where such laws are more protective than comparable federal laws. The Governors also insist on fulfilling their constitutional mandates to protect the public health, safety and welfare of their citizenry.

Task Force Recommendation #2

"The Energy Research and Development Administration should secure a Governor's concurrence prior to finalizing any loan guarantee for a synthetic fuels demonstration or development project within the Chief Executive's state."

The language contained in Section 17(e) concerning the Governor's concurrence is acceptable to the Task Force. If projects proposed under this program are to be successful, it is only common sense that the Governors should be involved in the decision-making process. The states have their own long-range

development plans, which may or may not be consistent with proposed projects for a variety of reasons. The state and federal government, as well as the industrial developer, must be fully apprised of the expectations and potential impacts which occur with large scale development.

Task Force Recommendation #3

"Congress should provide a mechanism within any loan guarantee program to fully involve the states as partners in the decision-making process for synthetic fuels demonstration and development."

This recommendation is partially addressed in Section 17(e) whereby the Administration is to inform the Governor of the affected state and officials of each political subdivision and Indian Tribe which may be impacted by a demonstration facility.

Although not specifically addressed in the legislation, ERDA has been formulating plans to create a Synthetic Fuels Environmental Advisory Board which would allow representatives of affected states to participate in a number of decisions surrounding synthetic fuels demonstration and commercialization. The Task Force recommends that ERDA create this Advisory Board before any project awards are granted, in order that affected parties can officially provide input to the Administrator on proposed demonstration projects.

Task Force Recommendation #4

"As a condition precedent to any loan guaranteed project, a full assessment of the direct and indirect cost to the state should be made and their amelioration should be assured. Local residents should not unfairly bear the cost of synthetic fuels development."

Although the issue of impacts directly resulting from proposed facilities is covered in Section 17(c)(5), we urge that amelioration of all impacts should be assured. The legislation does provide a number of mechanisms for dealing with community development as necessitated by loan guaranteed projects under this section. Various mechanisms, including loan guarantees to communities, direct loans, planning grants, as well as the ability for the Administration to "internalize" community development costs into the "total cost of the facility" are financing tools which are essential. In some cases, however, it may be absolutely necessary that direct grants be made available to off-set front-end financing problems for local political sub-divisions.

Depending on where a particular facility may be located, there will be a need for new schools, water and sewer facilities, police and fire protection, roads and highways, and a health program. In many sparsely settled areas there is virtually no local government. The bonding capacity of many states and counties is hampered by statutory dollar limitations and other restrictions, including a requirement in several states that there be a referendum before bonds can be issued. This could cause problems of uncertainties and delay which would frustrate a national effort.

America has long since learned that a community consists of more than physical services. A community must be planned so that there is an integrity to the activities which occur within its limits. Local government must relate to the activities and the population. Population should not be solely a function of a single industry.

A community must fulfill the needs of a variety of people who want different opportunities for recreation, social interaction and life styles. Different income groups must be accommodated and different age groups should be included

if there is to be stability. Indeed, executives of a major industry in today's world knows that there will be a range of people needed to staff a new facility in a complex technology. Recruiting and maintaining a workforce may be impossible in an area where the "new town" does not serve the range of interests that a diverse population seeks.

We must learn from our experiences from the classic "boom towns". The increased incidences of alcoholism, boredom, crime and resulting decline in productivity must be ameliorated if we expect these projects to succeed.

Particular attention must be given to building infrastructure capacity that will accommodate the population influx during the construction phase of synfuel facilities. Many of the services that are normally borne by the private sector may not be provided because of limited life expectancies. A number of these services will have to be provided from the public sector.

Therefore, funding must be provided to plan the new communities in a comprehensive way, and special techniques must be provided to fund the public services that will be required to accommodate people in a way which will be an asset to the state in which the new technology occurs.

The states have reviewed the various alternative means of helping to finance public services which will be required by some of the new synthetic fuels demonstration facilities. Several facts become evident from the review. First, the diversity among states and their subdivisions is so great that no single approach could cover all of the variations. Second, the problems will vary depending on the site selected and the nature of the plant to be constructed and operated; thus, it is impossible to devise a single approach that will cover all contingencies or even the range of predictable variations.

The Governors believe that the states and their subdivisions will be assuming risks and burdens as a result of these new, untried facilities and it would be unfair to ask them to assume the additional risks of the costs of the public services required to make these nationally sponsored efforts more feasible. It should be made clear that the solutions to any particular problem may require a mix of different approaches depending on the levels and differences among public facilities and services. Flexibility is the quality that can help the program succeed.

Task Force Recommendation #5

"Care should be taken within any loan guarantee program to see that synthetic fuels opportunities are developed throughout the country."

The legislation does not specifically address this important issue. The task force felt strongly that all regions of the country should be considered when demonstrating the commercial feasibility of various processes. A number of technologies can utilize a variety of different coals, and the true test of commercial feasibility should take this fact into consideration.

Section 17(e) requires the Administrator to submit a report to the Congress setting forth his recommendations on the best opportunities to implement a program of federal financial assistance. The Administrator's report shall include a comprehensive plan and program to acquire information and evaluate the environmental, socio/economic and technological impacts of the demonstration program.

I would like to propose an amendment that would aide in assuring that all parts of this nation are considered when reviewing various technologies. The amendment would be added as sub-section (3)(F) to Section 17(1) and read as follows:

"extent to which it is feasible to commercialize the technologies as it affects different regions of the country."

The effect of the amendment would in essence require that the Administrator also consider all regions of the country when reviewing various demonstration proposals.

Task Force Recommendation #6

"Oil shale development should be included in the initial stages of a Federal synthetic fuels program designed to assess the feasibility of such a technology. This initial stage of federally supported program to demonstrate the feasibility of oil shale development should support the smallest sized projects needed to understand and either approve or disapprove the technology in question."

This recommendation is appropriately addressed in the legislative proposal before you. My colleague, Governor Richard D. Lamm of Colorado, will address the specifics of this issue in his remarks before the Committee.

Task Force Recommendation #7

"Working with the states, it is the responsibility of the Federal Government to see that new technologies are tested and refined prior to full-scale commercial application. Therefore, we would support a Federal loan guarantee program for the purpose of demonstrating the commercial feasibility of synthetic fuels production, recognizing that the commercial production of energy should be provided by the private sector."

The Governors concur that it is the proper role of the Federal Government to demonstrate new technologies for the purpose of assessing their commercial viability. At the same time, we also feel that it is the proper role of the private sector to commercially produce energy in the long term.

Our recommendation of supporting a Federal loan guarantee program for purposes of demonstrating commercial feasibility should in no way be construed to recommend at this time, a federal program of price supports or regulatory modification for cost of service inclusion in the state utility rate base of synthetic gas. The Governors will respond to these issues as legislation or appropriation requests in these areas are considered.

Again, we are entering a unique phase in our domestic energy future. Traditionally, technology evolution has proceeded to the commercial stage only after careful development in our laboratories. The synthetic fuels proposal before us takes a different course than the incremental approaches of the past. It takes first generation technologies to the demonstration stage much faster. There are economic risks, but also great benefits should we succeed. With the proper safeguards, the risks can be minimized.

The information that this program may yield in the environmental and socio/economic areas can be extremely valuable toward the goal of reducing our dependence on foreign energy products. We must monitor and evaluate the programs findings with great care, being mindful of the consequences both pro and con.

Mr. Chairman, let me thank you and the members of this Committee for extending to the National Governors' Conference the opportunity to comment on this important piece of energy legislation. The nation's Governors continue to stand ready to assist in the development of our National Energy Policy. In addition, I would like to personally thank you, Mr. Chairman, for the personal invitation to appear before you today.



State of Colorado

EXECUTIVE CHAMBERS

DENVER

RICHARD D. LAMM
GOVERNOR

Statement Before the House Science and Technology Committee on HR 12112

by
Governor Richard D. Lamm*

It is awkward for a Governor to address a specific measure such as this dealing with the stimulation of synthetic fuels, apart from such issues as energy conservation and alternative energy resources. However, because of this nation's vulnerability, we are not afforded the luxury of withholding action until such a policy is developed.

Although my purpose is to address matters concerning the production of fuel through synthetic processes, I feel compelled to begin by underscoring the need for Congress to deal with energy conservation in an imaginative and aggressive way. As we stand on the verge of initiating federal support for the demonstration of synthetic fuels technologies and observe that perhaps as much as 30% of the potential we hope to harness will be wasted because of imperfect conservation technologies and consumptive lifestyles, one must be drawn to the realization that energy conservation must be the keystone of any natural energy plan or policy.

It is unfair to ask certain citizens of this country to suffer the impacts of energy development if the nation itself has not made a commitment to use the energy in a sensible fashion.

* Governor of Colorado and Chairman of the Synthetic Fuels Task Force of the Natural Resource and Environmental Management Committee of the National Governors' Conference

There has been general criticism of attempts to place the integrity of the U.S. Treasury behind various energy demonstration projects such as solar, energy conservation and synthetic fuels. While we do not support federal subsidies for commercial fuel production, it is entirely proper to utilize a loan guarantee mechanism to start up and investigate new technologies. Such an investigation or demonstration of synthetic fuels technology is needed to do more than simply better understand the technology itself. The highest degree of environmental amelioration is necessary in order for synfuels development to proceed. Demonstration projects such as envisioned in HR 12112 could give us the critical answers that we need with respect to environmental impact, as well as answer many of the environmental questions which remain unanswered.

There is another aspect of the Bill which is very important, that is, the broad range of technologies which is addressed dealing in both the renewable and non-renewable resource areas. While a strict allocation of loan guarantee ability across these technologies would be unwise, we feel that there should be some direction by Congress to see that the \$2 billion authorization benefits not only non-renewable resource development, but renewable as well.

Over the next few years, the United States will have to call upon a broad mix of technologies to close the gap between energy production and energy consumption. It is certainly in the national interest to investigate in a controlled manner all promising and potential sources of closing this gap. The demonstration of synthetic fuels technologies falls into this category.

Just as with exploration of space in the 1960's, demonstration of new energy technologies should be important to all Americans.. We therefore

support a bill to provide a moderate level of loan guarantees for the demonstration of synthetic fuels.

As you know, both the National Governors' Conference as well as individual governors were afforded the opportunity to appear before a subcommittee of this Congressional committee last year, to discuss the subject of synthetic fuels. That testimony is a matter of record, and I will not take your time in going through it again. It must be said that HR 12112 is a sophisticated beginning, and does include many of the points which the governors have previously raised, such as the need for gubernatorial concurrence. However, as presently drafted, we feel the Bill does not adequately address two very crucial points upon which we must condition our support of HR 12112. These are: the applicability of state laws and methods of dealing with the socio/economic impact resulting from synthetic fuels development.

Applicability of State Law

The extent to which sovereign states can apply their laws and regulations to the public domain has not been fully resolved. We obviously feel that the application of our laws, which serve to protect the health, welfare and safety of Coloradans, is a proper exercise of the policy power both on and off federal land.

In a number of cases, however, Congress has avoided the uncertainty of this constitutional debate. That is when Congress specifically has delegated authority to the states, together with the requirement that certain minimum standards be honored as with air and water pollution control laws.

Because of this precedent and because of the fact that synthetic fuels development is a high risk venture, I deem it completely appropriate and

necessary for the federal government to clearly acknowledge the applicability of state reclamation and facility siting laws if they are as stringent as the federal, to these very limited facilities.

Such a specific acknowledgment should be found in the legislation itself so that there is no question as to the federal intent of allowing the states to apply their laws to the projects which would be guaranteed under HR 12112. The states feel this is an extremely important condition to our support. In order to address our pressing energy problems in a timely fashion, the federal government is going to need the full cooperation and partnership of states. There is no better way to insure such a partnership than to allow states the full ability to assure for the protection of their citizens.

Socio/Economic Impact

The purpose of the loan guarantee strategy is to reduce the level of uncertainty and risk involved with building a commercial demonstration facility. Recognizing that such synthetic fuels projects have the potential of causing a high level of socio/economic impact, the states are asking the federal government for an equal level of certainty that such impacts can and will be ameliorated.

HR 12112 does provide a number of specific tools for dealing with community impact. The major delivery mechanisms, however, appear to be loan guarantees and direct loans. It is vitally important that the community impact assistance mechanisms be immediately available upon finalization of a guarantee for plant construction. A system based on loans to states and local governments may not provide the criterion of immediacy. The utilization of a loan or even a loan guarantee may hinge upon substantial institutional changes, requiring either legislation or constitutional modification.

In addition, the ability to deal with the impact in a "front end" manner may be frustrated by the inability to successfully pass a local bond proposal. Local citizens, in energy impact areas, have become very suspicious of programs which force them to bear the responsibility of dealing with the impact of the intrusion of energy related growth.

I can understand why local residents are apprehensive. Jack Gilmore, a leading authority on community impact, from the Denver Research Institute, predicts that even under the best circumstances of a federally guaranteed loan, local debt service might increase the total householder's burden of taxes and fees $1\frac{1}{2}$ to 2 times its present rate.

These issues, such as limits to bonded indebtedness, individual tax burdens and the ability to successfully adopt local bond proposals, are extremely awkward mechanisms around which to build a comprehensive impact amelioration system.

The limited nature of this synthetic fuels demonstration program, together with the high risk that it carries, would dictate in our minds a more straightforward and expeditious approach for dealing with the socio/economic impacts. I would suggest that in this case it would be entirely proper to utilize a special grant system for community development costs, resulting from the development guaranteed under HR 12112. Congress has recognized the necessity for utilizing grants in the case of Outer Continental Shelf legislation, which is pending in both Houses. Such an application might very well be necessary in the case of synthetic fuels development.

In addition, the legislation still does not provide an assurance that socio/economic impacts will be ameliorated. HR 12112 simply provides that the Administrator must determine that the impacts resulting from the proposed

facility have been evaluated and that effective steps have either been taken or are planned to be taken to finance such community planning and development costs. We strongly feel that it is incumbent upon the Administrator to not only find that the situation has been properly evaluated, but that the steps which either are being taken or will be taken are adequate to properly ameliorate socio/economic impacts. There must be an assumption of responsibility in this area, and we think that it is proper for the Administrator to assume the responsibility of seeing that these impacts are being adequately dealt with prior to finalizing any loan guarantees. It would simply not be acceptable to be in a situation where the construction of a facility was proceeding, but community development programs languished either while appropriations bills wound their way through Congress or where a state was unable to fully utilize federal assistance because of it being spread among numerous uncoordinated programs.

Oil shale development has gained a great deal of attention within the legislation. It is a potential fuel source that only affects two or perhaps three states. As the Chief Executive of one of those states, however, I would like to address the subject with a degree of specificity.

Oil from shale may some day be an important part of fuel mix. However, there are enormous questions for which there are simply not adequate answers at this time. These questions deal not only with the technical feasibility of the retort process, but run directly to the matter of whether or not oil shale development can proceed to full scale commercialization in an environmentally, socially and economically acceptable manner. It makes a great deal of sense to investigate the technology, through a modular demonstration approach now when we clearly have the time to understand both the costs and benefits of oil shale development.

In supporting the inclusion of oil shale in HR 12112, I feel that it is important to make a number of specific points:

1. We view HR 12112, together with its authorization for two billion dollars in loan guarantees as a complete demonstration package relative to oil shale development. The bill should assure that a few single retort plants will be built, which will demonstrate varying technologies and give all parties the important information that is needed to better judge the potential of oil shale. We expect to be able to monitor and evaluate any plants constructed with the assistance of this authorization, prior to any expansion of the program dealing with oil shale. Colorado will not be a party to a piecemeal approach. We assume that the authorization found in HR 12112 is sufficient to answer the major questions currently surrounding oil shale, and we would oppose an expansion of authorization in the near term, until the performance under this initial phase has been evaluated.
2. Any utilization of HR 12112 to demonstrate the potential of oil shale must distribute the projects among the various technologies available. We place a very high emphasis on in situ development in Colorado because of its potential for being the least damaging approach. We also feel that projects should be distributed in an equitable manner between the states which possess an oil shale potential.

One of the unanswered questions which a demonstration project must address, in our opinion, is whether or not oil shale development can proceed in an environmentally acceptable manner. In order to investigate problems, it is

vital that the best technology, commercially available, be employed to ameliorate the environmental impact of the demonstration projects.

Because of the very high risk and uncertainty of oil shale development, there must be clearly understood limits placed on the scale of demonstration facilities. There is in our minds a method of exploring the technology in a manner that will not only give us answers to important questions, but will allow us properly to monitor and evaluate the technology and its impacts.

We are referring to a "modular approach" for oil shale development. A modular approach is one utilizing a single retort of a limited size in order to demonstrate the technology and judge the impacts. It is important to understand that the manner in which a full scale commercial oil shale operation is built is to employ the sequential construction of a number of "modules," each with a capacity of processing up to 12,000 tons of shale rock per day.

We strongly feel that limiting the size of the facility to a maximum of 12,000 tons per day is wholly consistent with the demonstration nature of this legislation. While HR 12112 does address the modular approach, the present draft suffers from a degree of vagueness. Therefore, a specific limitation in the legislation would remove much of the uncertainty that we have with respect to the impacts of this legislation upon the State of Colorado.

The relationship of a modular approach to federal subsidies for the demonstration of oil shale technologies is important to understand. We strongly feel that regardless of whether the technology is demonstrated with or without federal assistance. . . on or off federal land, a modular approach makes sense. We simply must have a greater degree of knowledge before making a commitment for full scale commercial production.

However, restricting industry to modular development during this demonstration phase will necessarily provide an uneconomic condition for industry. Weighing the benefits of a paced, modular approach, I find sufficient justification for federal assistance for industry in this initial demonstration phase.

Testimony on H.R. 12112

Submitted to the
Committee on Science and Technology
U.S. House of Representatives

April 14, 1976

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In November 1975, as Congress considered H.R. 3474, the \$6 billion synthetic fuels loan guarantee bill, the Scientists' Institute for Public Information (SIPI) released a preliminary study reviewing the known relationship between the production of synthetic fuels and a significantly increased incidence of cancer. We cautioned then that neither research nor experience supported ERDA's enthusiasm in promoting rapid commercialization of technology to manufacture synthetic fuels from coal and oil shale.

Now that Congress is once again considering synfuels legislation, this time a more moderate \$2 billion loan guarantee program, we submit herewith our report "Synthetic Fuels and Cancer" as written testimony.

Following a confrontation in December 1975 between the author of SIPI's report and ERDA's James Liverman, Assistant Administrator for Environment and Safety, ERDA was sufficiently concerned to initiate with TRW the immediate compilation of a comprehensive bibliography to document thoroughly all published information on synthetic fuels and cancer, as well as all current and planned projects of government agencies, universities, and industry. It is reasonable to expect the results of that study, and also testimony from experts solicited from those sources, to be included in any hearing record concerning the fate of synthetic fuels legislation.

ERDA's own Draft Environmental Statement on the Synthetic Fuels Commercialization Program - released with the date December 1975 after several months' delay in consideration of health effects - is replete with warnings on the carcinogenic hazard of synfuels technology to workers and the general public. There is within ERDA a growing and increasingly audible discord between energy "doves" on one hand, who urge caution in adopting potentially harmful technologies, and the energy "hawks", who would charge ahead at any cost.

Yet input from the dissidents at ERDA - let alone other agencies, and industry - is not reaching the public, or indeed, Congress. ERDA's pronouncements - including Dr. Seaman's testimony before this committee - publicize only the need for implementing the commercialization program. ERDA's new, revised Fact Book, dated March 1976, addressed to Editors and Correspondents, has a sheet on Environmental Impact only several lines longer than the October 1975 version, wiser in no substantive way.

The Fact Book identifies the objective of determining potential impacts of synfuels commercialization. It does not acknowledge that synfuels technology is already known to have caused cancer in the past. It does not name cancer as one of the impacts to be studied. It does not admit that cancer may be generated in the process of monitoring for impacts. It does not hint that the humans at risk will be informed of their "guinea-pig" status in the course of the commercialization experiment.

We fear the same consequences in the synfuels program as have plagued nuclear development, promulgated by the reluctance to offer a program up for unrestricted scrutiny and change at the earliest planning stages rather than after commitments have been made. This has led with nuclear power to expensive delays and cancellations, expensive loss of capital, unavailability of supporting technology, and uncalculated greater expense as "afterthought" efforts are made to make safe an inherently hazardous technology. While environmentalists have become scapegoats on whom to "blame" difficulties in nuclear progress, an earlier concern with their apprehensions would have proved to be more economic and less disruptive in the long run.

H.R. 3474 was defeated last year largely on economic grounds. Since then, a national consciousness is growing of cancer as a predominantly environmentally caused disease - 1.3 million Americans have died in the last five years from cancer environmentally linked to toxic substances. An awareness of the economics of cancer is certain to follow. A moratorium is therefore particularly appropriate on legislation to promote a synthetic fuels commercialization program until all the known data are opened to widespread public and Congressional discussion, and at least until effort has been made to summon forth the experts whose doubts have not been incorporated in the policy-making process.

Testimony on H.R. 12112

Submitted to the
Subcommittee on Energy and Power
Committee on Interstate and Foreign Commerce
U.S. House of Representatives

May 28, 1976

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The Scientists' Institute for Public Information (SIPI) intends, in this testimony, to comment upon the internal conflict exhibited by ERDA in the presentation of its synthetic fuels program. ERDA seems to be of two minds, with one admitting there is no doubt of a definite cancer risk and meticulously defining its nature, and the other straining to charge ahead immediately with full commercialization. Meanwhile, industry is able to exploit the situation to its own benefit. It is reasonable to expect ERDA to resolve its own confusion and formulate a clear and consistent position before requesting Congress to consider funding of its program under H.R. 12112.

The administration of ERDA is actively seeking \$4 billion loan guarantee authority and authorization to promote full-scale synfuels demonstration projects. At the same time, ERDA's biomedical research staff acknowledges that data is lacking to conduct a cost/benefit analysis of the synfuels program. That data would include quantification of the health effects and population size that would be exposed by the demonstration projects as well as full commercialization. ERDA's biomedical research efforts have just recently been reprogrammed to explore the ability -- which they admit -- of synfuels technology to increase the rate of cancer in workers and the public.

The staff is only now in the process of collecting printed references which have long been available on what they call "deleterious impacts" of synfuels production and use. ERDA labs are only beginning to identify the carcinogenic potential of the agents released in these technologies, to determine their composition and size, to characterize their activity and interactions, the degree of their toxicity, the possibility of recovery from their effects. They are cooperating with other agencies, so that studies just designed and initiated by the Environmental Protection Agency would be available to them -- studies to characterize potential plant emissions, survey the adequacy of existing protective equipment, and determine the need for new equipment.

From what is known so far, ERDA's biomedical staff is able to state unequivocally that in the developmental phase -- what we are talking about in the loan guarantee program -- occupational exposure to potentially hazardous organic and inorganic agents will occur; that these agents will be found in process streams, products and effluents of the facilities; that some, the polycyclic aromatic hydrocarbons, are known to be carcinogenic, and that others not yet characterized are suspect, but that most have not been evaluated for mutagenic, teratogenic, or carcinogenic activity! They also state that the general population near demonstration or commercial facilities will be exposed.

Yet they are able to declare with premeditation that detection and characterization of hazardous agents is an important part of the strategy during the development phase to secure environmentally acceptable technologies. Although workers will be assured union scale wages for working on demonstration projects, what premium will they and local communities be paid for participating in this unprecedented experimentation?

In no testimony that we have seen before Congress has the administration of ERDA named these very real cancer risks and their costs, although environmentally caused cancer is becoming acknowledged as an emerging national epidemic. Parenthetically, the state of New Jersey is in process of determining whether there is a direct connection between the high concentration of chemical industries and its cancer mortality rate, which is the highest in the nation. It is expecting Federal government grants to help pay the millions needed to find retrospective answers and institute remedial measures.

Robert Fri, in his May 25, 1976 testimony before the Subcommittee on Energy and Power, is still referring vaguely to the value of the demonstration program in providing vital information on "environmental acceptability." While he details key modifications made to H.R. 12112 by Science and Technology, he fails to list the proposal adopted to require ERDA to study possible carcinogenic impacts of synthetic fuels. Likewise, the cancer hazard is not named as such in the Fact Book made available to Congress

and to the media for the transmittal of information to the public. Again, there are only references to "determining environmental impacts of commercialization." If cancer is going to be a problem, what is the administration waiting for in issuing warnings?

Dr. James Liverman, ERDA's Assistant Administrator for Environmental Safety, offers a guarded prognosis in defense of synfuels development. In his opinion, potential risks may be minimized by identification of hazardous agents, and development and employment of safety and control technologies. He anticipates that protective strategies will be implemented that would limit worker contact, which probably, he believes, accounts for low incidence of toxic effect in petroleum refinery workers. It should be pointed out that studies are only now being initiated by ERDA to compare the toxicity of petroleum distillates with that of synthetic fuels distillates. Additionally, indications are that synthetic fuels plants will be more expensive than petroleum refineries to bring to the same degree of occupational and environmental safety.

This then raises the question of what standards the current projects will be constructed to meet. According to ERDA's biomedical staff, the air quality standards for agents that cause cancer to occupational groups are based on acute disorders produced by exposure to high levels of pollutants. Little is known or accounted for in present standards about the long-term health risk associated

with low-level exposure, or the progression of the biological processes that may lead to cancer. Current water quality standards do not regulate the release of some carcinogenic agents to the public because the information for setting those standards is inadequate or non-existent. ERDA admits that continuous low level exposure may in the long run be the major health cost.

ERDA is relying on industry cooperation to "self-regulate" to prevent what it terms the "expensive retrofitting of control devices and methods" at some later time. Moreover, we understand that monitoring will be the responsibility of industry, not ERDA, at each individual project.

So we must ask, with what honesty is industry approaching the reality of this situation? A case in point is the behavior of the Oil Shale Corporation, which is engaged in a public relations campaign to convince us of the safety of their product. Their representative, Dr. R. Merrill Coomes, spoke at the 9th Oil Shale Symposium at the Colorado School of Mines in April 1976. He doubted whether cancer-causing agents could pose any direct threat to workers at a modern oil-shale complex, ignoring the difficulty of describing with certainty the qualities of a complex that does not exist.

He asserted that modern industrial hygiene practices would keep

the cancer risk low, without admitting that it is unclear what exposure would be considered low risk, or that industry may not be willing or indeed able to spend the money required to keep the risk low.

Most deceptively, he described the results of an experiment where mice were bedded on raw shale rock and spent shale, and developed no skin cancer. He failed to report on the condition of the lungs of the mice, although inhalation of particles represents a greater cancer hazard from raw and spent shale than contact does in inducing skin cancer. He also failed to report on a previous experiment he has conducted, where whole shale oil produced skin tumors in 78% of the mice tested, and upgraded shale oil produced tumors in 10% of the animals.

In conclusion, we would like to ask just what Congress would be guaranteeing and for whom in agreeing prematurely to a synthetic fuels loan guarantee program. Will it be asking the American public to subsidize, with its long-term anguish, the short-term profit of a few corporations? A valid accounting would include figures on how many people will be exposed and can be expected to contract cancer, what the costs of their health care would be, what the costs will be of enclosing and automating the synfuels facilities, of removing and containing toxic substances from air and water emission, of building in these precautions or retrofitting later, and how this will affect the true costs of gas and oil produced by synthetic fuels technology.

We are including for the hearing record testimony we submitted on April 14, 1976 to the House Science and Technology Committee, our paper of November 1975 on "Synthetic Fuels and Cancer," Dr. Liverman's letter of May 21, 1976 to the Scientists' Institute for Public Information, and ERDA's "Health Effects of Coal Combustion and Conversion."

SYNTHETIC FUELS AND CANCER

November 1975

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Congress is considering authorization of a loan guarantee program to further the Administration's Synthetic Fuels Commercialization Program. This would initiate large-scale construction of manufacturing facilities for fuels obtained from oil shale and liquefied and gasified coal, even before the Energy Research and Development Administration's Draft Environmental Statement on this program is released. We therefore offer the following relevant information on the known relationship between synthetic fuels and cancer.

The carcinogenicity of synthetic fuels results from the chemical composition of the raw materials from which they are derived--the kerogens in oil shale and bitumens in coal--and also from the temperatures at which they are processed, which form and release a wide range of polycyclic aromatic hydrocarbons (PAH). PAH as a family are the earliest known carcinogens. Those established in their carcinogenicity to humans are benzo-pyrenes and benzanthraces.

Polycyclic aromatic hydrocarbon compounds are lipid soluble, and enter cells easily. Because of their circular molecular shape, they fit into the structure of DNA--hence their designation as "intercalating agents"--and begin to react with it. Enzymes in the cell are mobilized to repair damage thus caused to the DNA, but the repair process itself initiates mutation

in the genetic material where the PAH occurred. The mutation is duplicated in daughter cells when the parent cell divides, and can be the beginning of cancer.

Healthy mouse embryo cells have been morphologically transformed by the addition of pure benzo(a)pyrene (formerly called 3,4 benzpyrene) under laboratory conditions. When these cells were inoculated back into mice, subcutaneous sarcomas developed (Sivak and Van Duuren, 1968).

Workers with occupational exposure to synthetic fuels will be in particularly serious jeopardy, although even with controlled plant emissions, the general public will also be at risk. This was acknowledged in the Synfuels Interagency Task Force report submitted to the President's Energy Resources Council:

"Some damage to...humans from air pollutants may be unavoidable. Adverse human health effects, including cancer, might result from long-term exposure to polycyclic aromatic hydrocarbons and trace elements emitted from synthetic fuel plants in the form of or adsorbed on fine particulates. Some increase in sulfur dioxide, nitrogen oxides, trace elements, hydrocarbons and respirable particulates will occur even though emission controls are employed and air quality standards are enforced." (p.IX-3)

A synergistic as well as additive hazard is indicated by some researchers. The air-borne presence of nitrogen- and sulphur-containing molecules* could augment the development of skin and lung cancer (Eckardt, 1960), a co-carcinogenic effect which has been confirmed in animal experiments (Eckardt, 1973).

* present in relatively low concentrations in the petroleum industry

The Task Force report continues:

"Construction and use of synthetic fuels processing plants can...cause release of toxic waste to streams, and return of production water to stream channels. Even with controls, some release would occur..."

Shale Oil

The human carcinogens benzo(a)pyrene, benzo(e)pyrene, and benzo(a)anthracene and other PAH are present in shale oil. Benzo(a)pyrene would be contained in the waste processing waters, and in compounds used to remove the benzo(a)pyrene from waste water (Veldre et al, 1965). Shale oil fractions without benzo-pyrene have as well been shown to be carcinogenic when applied to mice (Hueper and Cahnmann, 1958).

The carcinogenic potential of shale oil has been known since 1876, when cancer of the scrotum was first described in a Scottish shale oil worker. Between 1920 and 1943, there were over 1000 verified cases of skin cancer in the British mule spinning industry, which then used shale oil to lubricate spindles (Commoner, 1975). Skin cancer has also been reported in workers in contact with the retort (combustion) tars (Danetskaya, 1953), light oils, waxes and cutting oils derived from shale (Auld, 1950).

Shale oils are generally more carcinogenic than any of the petroleum oils. A worker exposed to shale oil is fifty times more liable to get skin cancer than a worker in contact with oil from a Pennsylvania well (Hueper, 1942).

Each shale oil plant of the size currently being proposed --50,000 barrels per day--would process up to 30 million tons of oil shale per year (Fri, 1975). Spent (waste) shale from surface retorting would amount to as much as 26 million tons per year, containing over 300 tons of carcinogenic materials, and covering 50 surface acres of waste for each year of operation (Schmidt-Collerus, 1974).

Disposal would include the filling of canyons in the West, and the building of soil banks in the East. Leachate into the groundwater and surface run-off containing polycyclic aromatic hydrocarbons, as well as lead, mercury and other toxic trace metals, would enter the food chain. In addition, 300 million gallons of PAH-laden waste water would be produced during the retorting process alone.

One such facility would employ 1100 to 1500 operating personnel. The total incremental population of a surrounding new town to support the plant is estimated to be about 11,000 to 14,000 people (Fri, 1975). The Federal Energy Administration's Project Independence Blueprint projects five of these plants in operation by 1985, in towns housing up to 70,000 people, including up to 7500 shale oil workers.

Liquefied Coal

At least 200 individual chemicals have been isolated and identified which are liberated when coal is liquefied, including benzo(a)pyrene.

Between 1952 and 1959, the Union Carbide Corporation operated a coal liquefaction plant in Institute, West Virginia, employing a total of 359 workers in the hydrogenation process (Sexton, 1960). From evidence with experimental animals and from experience in related industries handling coal tar products and shale oil, it was suspected in advance that skin cancer might be induced. Protective garments standard to "dirtier" chemical operations were therefore used from the beginning.

By 1954 it was determined that extensive contamination was nevertheless occurring. A Health Hazards Committee was formed. Workers were cautioned to avoid unnecessary contact with oils, were given instruction in regard to decontamination practices, and were provided with changes of clothing. Sampling studies were initiated. Efforts were made to identify and correct hazardous equipment and techniques (Weil et al, 1960; Ketcham and Norton, 1960).

Despite these precautions and repeated, careful examinations of the workers, the incidence of skin cancer in the seven years of operation of this coal liquefaction plant was between 16 and 37 times that previously reported in the literature. Skin

cancer developed after as little as nine months' exposure (Sexton, 1960). This is in contrast to experience reported in the petroleum industry, where no cancer was observed in workers after 15 years' exposure to petroleum oils which had been highly carcinogenic to the skin of mice (Eckardt, 1960).

While the early, unavoidable debugging period was held responsible for some excessive exposure, as late as 1956 air samples showed as much as 1870 micrograms of benzo(a)pyrene per 100 cubic meters of air on the plant premises. This compares with air samples taken in 1953 in a high traffic area of Los Angeles, showing 2.9 micrograms of benzo(a)pyrene per 100 cubic meters of air (Ketcham and Norton, 1960).

In retrospect, it was suggested that skin contamination resulting from airborne dusts, vapors, fumes and mists derived from the coal tars may have been more detrimental than direct contact with liquids in the manufacturing process, which forbodes danger to the public from plant emissions.

Prior to 1952 there had been 17 years of exposure of a great many men to the coal liquefaction process in laboratory-sized and small-pilot plants. No cancer had been observed until this large-pilot, but still not commercial-sized plant, began operation (Sexton, 1960).

ERDA and Coalcon, a joint venture of Union Carbide Corp. and Chemical Construction Corp., have just announced plans to co-finance a demonstration plant, 30 miles southeast of St. Louis, to liquefy coal into oil and also produce synthetic natural gas (Business Week, Dec. 1, 1975).

Gasified Coal

Coal tars appear in the gas produced from bituminous or sub-bituminous coal at commonly used gasification temperatures (Squires et al, 1974). Benzo(a)pyrene has been isolated from coal tar.

The history of coal tar cancers began in 1775 with the observation of scrotal cancers in chimney sweeps, and ranges through contemporary observations on cigarette smoking and cancer. Skin cancers in coal gas workers were reported in 1892 (Butlin, 1892). In comparison with a general population rate of scrotal cancer mortality of 4.2 per million, producer gas men (those who generate coal gas to meet the demands of the plant where it is produced) have been reported to have rates of 10.9 per million, and coal gas and coke makers who work on top of the ovens, where the effluents are greatest, have an incidence of 1239 per million (Lloyd, 1971). A much higher skin cancer rate has been reported for tar distillery workers handling gas works tar than for those handling coke oven tar (Heller, 1930).

A 26-fold excess of lung cancer mortality over the general population and 33 times the rate in other steelworkers was observed in Japanese bituminous producer gas workers in 1936 (Kawai et al, 1961 & 1967). An excess has also been noted in British coal gas producermen (Kennaway and Kennaway, 1947), and coal gas retort workers (Doll et al, 1965). Bladder cancer, possibly caused by 3-naphthylamine found in gas retort effluents, has been reported in Swedish coal gas workers. Excesses of cancers of the larynx, stomach, and pancreas, as well as leukemia, have also been reported (Lloyd, 1971).

The literature does not support ERDA's optimism in concluding that the synthetic fuels program is a "viable environmental protection strategy" (Fri, 1975). In fact, questions raised by research and experience make clear that caution is warranted, and that measures to prevent the induction of cancer must be given serious attention.

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UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
WASHINGTON, D.C. 20545

MAY 21 1976

Mr. Alan McGowan
President, Scientists' Institute
for Public Information
49 East 53rd Street
New York, New York 10022

Dear Mr. McGowan:

In your letter of May 3 to Dr. Robert C. Seamans, Jr. you requested that ERDA comment on the potential carcinogenicity of synthetic fuels.

The Energy Reorganization Act of 1974 declares as one purpose of the Energy Research and Development Administration (ERDA), "to advance the goals of restoring, protecting, and enhancing environmental quality and to assure public health and safety." As Assistant Administrator for Environment and Safety, it is my duty to ensure that energy technologies developed by ERDA are both environmentally safe and socially acceptable.

We in ERDA are aware of the potentially deleterious impacts of synthetic fuels production and use upon occupational and general populations. A significant portion of ERDA's biomedical research efforts has been reprogrammed to deal with these questions. I am enclosing a description of our program activities dealing with the health effects of coal combustion and conversion to provide you with an indication of the depth and breadth of our interests. In addition, my staff is in the process of preparing dossiers for our internal use on these impacts, which will include those references contained in the document, "Synthetic Fuels and Cancer," prepared by Ms. Diane Yale Sauter for your organization. These reports are currently being assembled, and copies will be sent to you upon their completion. In the interim, however, the following remarks may help to put the problem into perspective.

With respect to synthetic fuels technology hazards, we note that references to some of these hazards have been in existence in the open literature for approximately 100 years. The toxicity of shale oil was recognized in 1876, when the British physician, Dr. Benjamin Bell, described a case of scrotal cancer occurring in a Scottish



Mr. Alan McGowan

shale oil worker. In 1910, another British physician, a Dr. Wilson, prepared a resident's dissertation on skin cancer (principally of the scrotum) among mule spinners exposed to shale oil. These observations were published by Southam and Wilson in 1923. Since that time, various standard texts on occupational health and industrial toxicology have considered shale oil exposures hazardous to human health. Some of the carcinogenic components of shale oil have been identified, and it is suspected that many of these are produced during the pyrolysis (heating) procedure by which oil shale kerogen is volatilized to oil. It is of considerable interest to note that different oil shale deposits have different compositions and produce, during heating, different volatile fractions. Oil from shale may be fractionated by distillation to provide fractions of different carcinogenic activities. Some of these compounds are also mutagenic. In similar fashion the conversion of coal to liquid and gaseous fuel forms can produce substances which are toxic. This has been well documented.

Much of the aforementioned domestic information is quite dated, a circumstance of our limited interest in shale oil and coal conversion fuels in the 1950's and 1960's. Modern references quote the same dated information. Considerably more detailed information on this subject is necessary if our country is to invest heavily in shale oil and coal conversion fuel production. This fact was recognized in the preparation of the (King) Interagency Task Force on Health and the Environment in 1974 by participating Federal agencies (including ERDA, Environmental Protection Agency, National Institute of Environmental Health Sciences, and National Institute of Occupational Safety and Health). Interest in the toxicity of synthetic fuels and related products has been revived among health workers by the current role of the Federal Government in supporting synthetic fuels technology development.

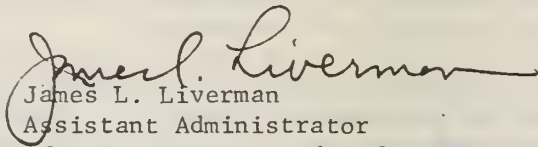
In our opinion, these potential risks may be minimized by the identification of hazardous agents and by development and employment of suitable safety and control technologies to ensure that neither workers nor members of the general public will be impacted by toxic agents associated with synthetic fuels production. I should also point out that these problems are not limited to synthetic fuels, but are shared by present day petroleum-based fuels. It is probable, in this regard, that the relatively low incidence of toxic effects in petroleum refinery workers may be accounted for by limited worker contact with process intermediates in automated and remote-operated modern refineries. It is anticipated that similar protective strategies will be implemented in synthetic fuel industries.

Mr. Alan McGowan

In summary, ERDA is well aware of the potential toxicities of synthetic fuel process components and products. Considerably more information is needed concerning these substances, and major ERDA programs are underway to produce this information. None of the potential problems are expected to be insoluble by technological means available as the industries mature. Our national need for plentiful and clean-burning synthetic fuels provides a strong incentive to solve these problems in timely fashion.

I hope that this response to your questions is satisfactory. Please feel free to contact me if you need further information.

Sincerely,


James L. Liverman
Assistant Administrator
for Environment and Safety

Enclosure:
As stated

HEALTH EFFECTS

OF

COAL COMBUSTION AND CONVERSION

INDEX

PART I. Program Justification	<u>Page</u>
A. Introduction	1
B. Health Impacts	2
1. Coal Extraction	2
2. Coal Processing	3
3. Coal Combustion	4
4. Coal Conversion	5
C. Planning Activities and Establishment of Priorities	6
D. Implementation of Program	8
PART II. Program Overview	10
A. Technology Oriented Objectives	10
B. Supporting Research	13
PART III. Detailed Program Objectives and Allocation of Funds	
A. Summary Table of Allocations of Funds by Research Objective	15
B. Detailed Description of Program Objectives	16
1. Technology-Oriented Objectives	16
a. Screening for Hazardous Agents	16
b. Fate and Metabolism	17
c. Pathophysiological Effects, including Respiratory Toxicology	18
d. Carcinogenesis	20
e. Mutagenesis and Developmental Effects	21
f. Molecular and Cellular Mechanisms	23
g. Recovery and Treatment	26
h. Human Health Studies	28

<u>INDEX</u> (continued)	<u>Page</u>
2. Supporting Research	31
a. Critical Organ Systems	31
b. Development of Improved Bioassay Screening Systems and Early Indicators of Damage	32
c. Genetic Research	35
d. Molecular and Cellular Studies	38
PART IV. Projections - Summary and Recommendations	43
A. Projections for Future Research	43
B. Summary and Recommendations	47

PART I. Program Justification

A. Introduction

B. Health Impacts

1. Coal Extraction
2. Coal Processing
3. Coal Combustion
4. Coal Conversion

C. Planning Activities & Establishment of Priorities

D. Implementation of Program

HEALTH EFFECTS OF COAL COMBUSTION AND CONVERSIONI. Program JustificationA. Introduction

The ERDA National Energy Plan advances an immediate and increasing role for coal in helping the Nation meet its goals for energy. Two major uses are contemplated for coal. For the near term, now to 1985 (and beyond), emphasis will be placed on developing and deploying methods for the direct utilization (combustion) of coal by utilities and industry to generate electricity and process heat. For the mid-term, 1985-2000 and beyond, priority will be placed on the exploitation (conversion) of critical gaseous and liquid fuels from coal. It is anticipated that these coal uses will be complementary in supplementing other national energy sources.

Coal will be supplied for conversion or combustion by underground or surface mining techniques. Coal combustion techniques (e.g., grate burning, reverse flow, fluidized bed) will be designed to accomplish certain ends and will be influenced by a complex mix of social, technological and economic considerations. For example, while efficiency of energy production will be one consideration, modification of combustion techniques may be necessary to achieve reduction of noxious emissions.

It has been estimated that the use of coal by utilities and industry could increase in the near-term to demand from 755 (conservative option) to 2,063 million (accelerated option) tons per year. Energy developments of this magnitude could have potentially damaging impacts on man and the environment. It is the responsibility of the ERDA Administrator to submit to Congress plans for solutions to near-, mid- and long-term energy supply systems and associated environmental problems.

The ERDA biomedical research capability must address the environmental and health implications of coal combustion and conversion technology and inform ERDA technology programs on these matters at all stages of development. A broadly-based ERDA biological and environmental research program completely interactive with and responsive to energy-technology programs will provide assurance that promising technology developments are compatible with the protection of human health and environment.

B. Health Impacts

Health problems associated with coal extraction, processing, and combustion and coal conversion are similar to some extent, but each phase has unique problems which must be addressed in terms of the specific chemical agents to which human beings will be exposed. Also the size of the population that will be directly exposed is different for various stages of the fuel process. For example, coal extraction, processing and conversion processes involve exposure of occupational and local groups while combustion of coal involves exposure of the general population to effluents. Segments of the general population may also be exposed to potentially hazardous chemicals in transportation or utilization of synthetic fuels derived from coal liquefaction. Moreover, large segments of the general population may be exposed to contaminated water or food resulting from run-off from waste a problem common to all coal technologies.

1. Coal Extraction

The chief health problems are created by dusts, suspended and soluble organic and inorganic chemicals. Most eastern and western coals will be obtained by surface mining which creates minimal health problems. Mining, including deep mining, will be required in the long-term. While

there are rigid standards for air levels of particulates, the most hazardous sizes (below 1-2 μM) are the most difficult to monitor. Particulates of this size range are composed of inorganic and organic chemicals and usually carry adsorbed organic and inorganic matter on them and are most apt to be respired and lodged deep in the lung. Damage to the lung and respiratory pathways is already known to occur as a result of long-term exposure to mine dusts and their associated trace and heavy metals and hydrocarbons. It is not known which of these agents are responsible for latent respiratory disease. These diseases are frequently accompanied by cardiovascular damage. In addition these same agents can gain entry through the lung and gastrointestinal tract and be translocated to other organs and tissues to produce a variety of damaging effects which lead to life shortening and cancer. Most air quality standards for occupational groups are based on acute disorders produced by exposure to high levels of these pollutants. Little is known about the health risk associated with low-level continuous exposure, or the progression of the biological processes that lead to disease states.

2. Coal Processing

This phase involves all processes from simple washing to fine grinding to produce slurries for potential transport by pipe-line. In some processes desulfurization will be done at this stage. The major health problems will be encountered in the suspended or soluble inorganic and organic chemicals in treated or untreated waste water. Although the release of some agents is regulated in terms of water quality standards, many are not because the information for setting standards is inadequate or does not exist. Self-regulation by ERDA and industry will be a

natural part of the technology development program in order to prevent delays and expensive retrofitting of control devices and methods at some later time.

Chemical agents that are ingested can be absorbed through the gastrointestinal tract and can be transported and translocated throughout the body and selectively deposited in sensitive tissues where they can produce a variety of pathophysiological effects especially in sensitive individuals. Although these agents will probably be present at low levels, small segments of the general population near demonstration or commercial facilities may be exposed.

3. Coal Combustion

Effluents from coal combustion are partially regulated. Present standards can be met regionally by various strategies for burning low sulfur fuels part-time and by careful siting of exclusively coal burning energy producing facilities. Widespread expansion of exclusively coal burning facilities will require clean-up of coal, large scale use of control devices and/or advanced technology in coal burning. Reconversion of residential heating to coal would merely compound the problems. Present standards for air pollution are based primarily on existing coal combustion technologies. Future standards will have to account for effluents from advanced coal burning developments as well as for those generated or altered by advanced control technologies.

In man the lung is the main target organ for gaseous and particulate effluents of coal burning facilities. Acute effects on sensitive populations, those with chronic respiratory and cardiovascular diseases,

produced by high exposure levels are well recognized and comprise the basis for air quality standards. Information about long-term health effects of continuous low level exposure is meager and thus is not taken into account in the present standards even though they may in the long run be the major health cost. A major gap in information is knowledge about the progression of a variety of pathophysiological states that ultimately lead to cancer and to other life-shortening or debilitating diseases.

4. Coal Conversion

Large scale production of useful liquid and gaseous fuels from coal is an emerging technology presently entailing a variety of research and engineering approaches to produce high quality synthetic crude oil and substitutes for natural gas. In the near-term the gasification developments will be at pre-pilot and pilot plant stage and liquefaction developments will follow by 5-10 years for demonstration and commercialization. It is important to realize that in the developmental phases occupational exposures to potentially hazardous organic and inorganic agents will occur. These agents are found in process streams, products and effluents of the facilities. Inorganic and organic substances likely to be present are trace and heavy metals and polycyclic hydrocarbons some known to be toxic, others are not yet characterized but suspect. Detection and characterization of potential effects of hazardous agents in the development phase is an important part of the strategy to secure environmentally acceptable technologies. Heavy emphasis will be placed on the polycyclic hydrocarbons because some are known to be carcinogenic. Most have not been evaluated for mutagenic, teratogenic, or carcinogenic activity. The skin and respiratory system are primary targets for damage

since both tissues represent the most likely routes of entry to the general circulation. Nevertheless, several other critical organs can become secondary sites for damage particularly for latent diseases and thus contribute heavily to major health costs.

C. Planning Activities and Establishment of Priorities

Program planning which is designed to meet the research needs of a rapidly developing technology requires:

1. A systems for establishing the health research priorities which is coordinated with the timelines established for the technology.
2. An appraisal and correlation of the national effort in health research which may be directly relevant to obtaining the required information.

The health and environmental effects planning was initiated early in 1973 as part of preparation for Dr. Dixie Lee Ray's report to the President "The Nation's Energy Future," published December 1973 (WASH-1281). In early 1974 an interagency working group was convened to conduct a similar study of research needs in "Health and Environmental Effects of Energy Use." This planning study culminated in a report prepared for OMB and CEQ in November 1974 referred to frequently as the King-Muir report.

Both studies convened panels of experts and representatives of science, technology and government agencies involved in energy-related environmental and health research. The plan and report respond to the consensus of perceived research needs and priorities, describe what the various agencies are doing in energy-related research and what would be the most effective use of available immediate increased funding. To a great extent, this state of knowledge of research needs is reflected in

the following table which appeared in the "Proceedings of the Conference on Health Effects of Air Pollutants," prepared for the Committee on Public Works, U.S. Senate in November 1973. The information which is required for assessing health effects is defined and becomes one criterion for setting priorities. Tables for nitrogen oxides and other agents have also been published reflecting similar needs. Future research must emphasize filling of the important gaps in knowledge for latent disease states, supplying important information in clinical aspects of progression of disabling disease, and determination of dose-effect relationships for most chemical pollutants. The ERDA plan of health research aims to fill these gaps in concern with other health-oriented agencies and with minimal overlap of research efforts.

Table 1. ADVERSE HEALTH EFFECTS WHICH MIGHT BE ATTRIBUTED TO EXPOSURES INVOLVING SULFUR OXIDES AND SUSPENDED PARTICULATES

Expected Effect	RESEARCH APPROACH		
	Epidemiology	Clinical Studies	Toxicology
Increased susceptibility to acute respiratory disease	Multiple studies	No data	Isolated studies
Aggravation of asthma	Few replicated studies	No data	No data
Aggravation of heart or lung disease	Multiple studies	No data	No data
Irritation symptoms	Multiple studies	Few replicated studies	No data
Altered lung function	Multiple studies	Few replicated studies	Multiple studies
Increased risk of chronic lung disease	Multiple studies	No data	No data
Cancer	No data	No data	No data
Congenital defects	No data	No data	No data
Impaired defense mechanisms	No data	No data	No data

Since the creation of ERDA, a systematic series of analysis have been made by experts in technology, investigators in health and environmental disciplines and technical research coordinators at ERDA. These interactive studies culminated in June with an ERDA workshop convened to produce a balanced health and environmental program plan.

All these efforts have included the establishment of priorities based on the following criteria; (1) severity of expected health effects, (2) magnitude of the problem (population size exposed), (3) need for information, and (4) urgency for information. Thus the priorities address the severity and magnitude of the potential problem as well as identify the most important information required to insure that the technological development will not be impaired or delayed because of a lack of data needed to conduct a cost/benefit analysis.

D. Implementation of Program

As a result of advanced planning and established priorities it was possible to initiate through reprogramming in ERDA laboratories a major health effects effort devoted primarily to emerging fossil fuel energy technologies. Implementation and funding was accomplished by judicious reorientation of research previously associated with nuclear energy (13 million) and using allocation of 6 million dollars from the special energy fund provided via interagency agreement for initiating or expanding new research initiatives.

Since ERDA and national priorities are committed to rapidly expanding the use of coal reserves, the health effects program is oriented toward health problems associated with direct use of coal in energy production as well as its use in production of synthetic liquid and gaseous fuel.

PART II. Program Overview

A. Technology Oriented Objectives

B. Supporting Research

II. Program Overview

A. Technology Oriented Objectives

Research in the Health Effects category is conducted primarily to define and quantify the impact of fossil fuel energy technologies on human health. To accomplish these and related goals, it is necessary to (1) identify hazardous energy-related physical and chemical agents, (2) identify adverse health effects induced by hazardous agents and develop an understanding of the pathophysiological basis for such effects, (3) develop and apply methods for the early detection and diagnosis of energy-related health effects, (4) obtain quantitative data on dose-effect relationships in humans and several animal species, (5) integrate the quantitative data from multiple species into predictive models that can be used to estimate human health risks under a variety of exposure conditions, and (6) develop improved modes of protection and remediation.

In order to assess human health risks properly, the magnitude of the dose of a hazardous agent must be quantitatively correlated with the magnitude of the biological effect in man. It is then possible to devise predictive models with which one can calculate estimates of risks or hazards for different levels and modes of human exposure. Predictive models are essential for setting and evaluating human exposure limits, for establishing guidelines with respect to the containment of hazardous agents, and for purposes of making cost/risk/benefit analyses used in long-range energy planning. The development of an adequate predictive capability requires a comprehensive program of research that includes human epidemiological and clinical studies, comparative studies in several animal species, the development of knowledge of cellular and molecular damage and relevant supportive research.

Research emphasis will center on evaluating health risks arising from chronic exposures to low levels of hazardous agents that may occur in work areas or the general environment at any stage of a fuel or energy cycle. Inhalation is considered to be the prime exposure modality and will receive major emphasis. The study of interactive effects occurring when biological systems are exposed to more than one agent must also be given high priority. Definition of the impact of chronic low dose exposure requires that the development of delayed or late effects must be characterized. Biological responses of particular importance include life-shortening, genetic effects, cancer, impairment of growth or development, chronic degenerative diseases of the cardiovascular and pulmonary systems, and functional impairment of other critical organs. The assessment of health effects applies not only to expanding on-line technologies (combustion of coal) but also to the array of new energy technologies, including coal conversion, currently in various stages of development.

Wherever possible, data on health risks should be obtained from human populations that have been exposed accidentally, occupationally, or for other reasons to energy-related agents known to be, or suspected of being, hazardous. It is essential also to obtain information on the metabolism and disposition of hazardous chemical agents to provide a basis for estimating their internal dose to critical organs.

Since opportunities for the study of exposed human populations are limited, and since such studies usually are lacking in adequate control of important variables, the development of health risk information must rely heavily on data collected from controlled animal model experimentation.

Since no mammal is a sufficient model for man, several species must be used and experimental conditions sought which make possible risk estimates for human populations. By using an interspecies comparative approach, insights are gained into species similarities and differences with respect to sensitivity to hazardous agents, patterns of response, metabolism of toxicants, and organs at particular risk. Such comparisons are used in developing predictive models applicable to human exposures. Short-lived small animals (rodents) are useful in large scale experiments designed to obtain statistically valid estimates of risk for low-dose exposures or for elucidating the influence of exposure conditions on observed effects. Long-lived large animals are used primarily to study the detailed sequence of structural and functional changes that precede or accompany specific diseases which appear only after a long period following exposure.

In view of the complex array of chemical agents that are associated with the coal-based energy technologies, it is not feasible to test in animal systems all potentially hazardous chemical materials of interest. Accordingly, animal studies will be conducted on a priority basis for those chemicals judged to be of greatest hazard. Priorities will be guided by data obtained from (1) physical and chemical analysis of crude fuels, ores, process streams, end products, effluents, and waste materials; (2) large scale rapid, invitro cell and organ screening program to identify the chemical agents of potential hazard for causing pathophysiological, mutagenic, carcinogenic or embryotoxic damage. This program will consider a large number and variety of chemical agents of potential toxicity and reduce and prioritize those agents of potential risk to human health; (3) a systematic evaluation will be made of how the agents identified as hazardous are enzymatically activated or

detoxified in the body as well as their deposition, retention in specific organs or tissues and excretion. These studies will provide information for the dose parameter of the animal testing program; (4) well-defined animal studies in several species will be conducted to develop detailed quantitative risk estimates in dose-effect terms.

B. Supporting Research

Although data from human epidemiological studies and controlled animal experiments are essential in the evaluation of health risks of hazardous agents, such studies encounter inherent statistical limitations in the very low dose range. Estimates of hazards of low level pollutants can be made with confidence only if (a) the mechanisms of action of pollutants at the cellular and molecular level are known, (b) there is a well-developed theory for extrapolating from cellular experiments to whole animal conditions and (c) the metabolic relationship between animal and human cells are characterized. Hence applied studies must be supplemented by supportive studies which can provide important insights into the normal structure and function of sensitive cells, tissues, and organs so that alterations induced by energy-related stresses can be more readily detected, quantified, and understood.

These supporting studies will include (1) investigations aimed at understanding the basic nature and normal function of organs and tissues that are uniquely sensitive to a variety of chemical and physical agents, such as the hematopoietic and immune system, reproductive cells and most epithelial cells that turn over rapidly for normal maintenance of body function; (2) research on the pathophysiology of disease induction to define the complex sequence of biological events leading to overt clinical

symptoms in the exposed organism and to clarify the nature of the functional impairments to critical organ systems which are prime targets for damage; (3) studies aimed at developing sensitive indicators of early damage to key organ systems in order to identify effects at earlier times and for ultimate application to man; (4) development of more sensitive in vivo and in vitro bioassay system for rapid and efficient detection of potential carcinogens, mutagens and teratogens; (5) molecular and cellular studies to elucidate mechanisms and consequences of somatic and genetic damage, to characterize protective mechanisms that function in the animal organism to combat external stresses and to understand individual predisposition towards disease; (6) genetic research at all levels of biological organization ranging from molecules to populations of organisms with major emphasis given to detecting potential mutagens, assessing their risk to man and elucidating factors affecting mechanisms underlying the production and repair of genetic alterations (mutations); (7) developing effective means of protecting exposed individuals against serious injury and with facilitating recovery in persons already injured by exposure to harmful agents; (8) developing theoretical and experimental models to perfect the extrapolation of animal data to man especially at low exposure levels. Of particular interest is developing needed animal disease models for man. Knowledge in the supporting areas of research rests upon a wide array of institutions in the biomedical sciences. The research programs in ERDA depend on these institutions and on the selective encouragement of fundamental research in ERDA laboratories and in universities.

PART III. Detailed Program Objectives and Allocation of Funds

A. Summary Table of Allocations of Funds by Research Objective

B. Detailed Description of Program Objectives

1. Technology-Oriented Objectives

- a. Screening for Hazardous Agents
- b. Fate and Metabolism
- c. Pathophysiological Effects, including Respiratory Toxicology
- d. Carcinogenesis
- e. Mutagenesis and Developmental Effects
- f. Molecular and Cellular Mechanisms
- g. Recovery and Treatment
- h. Human Health Studies

2. Supporting Research

- a. Critical Organ Systems
- b. Development of Improved Bioassay Screening Systems and Early Indicators of Damage
- c. Genetic Research
- d. Molecular and Cellular Studies

Table II

Allocation of Funds by Research Objective

A. Funding for Technology-Oriented Objectives

<u>Objectives</u>	<u>FY 76 Budget (K)</u>			<u>FY 77 Projection (K)</u>		
	<u>Base</u>	<u>Pass-thru</u>	<u>Total</u>	<u>Base</u>	<u>Pass-thru</u>	<u>Total</u>
Screening	947	1000	1947	1226	1000	2226
Fate and Metabolism	535	386	921	738	386	1124
Respiratory Toxicology	923	600	1523	1519	600	2119
Pathophysiology (Other)	1681	100	1781	2084	100	2184
Carcinogenesis	565	700	1265	808	700	1508
Mutagenesis and Developmental Effects	818	686	1504	1326	686	2012
Molecular and Cellular Mechanisms	3068	885	3953	3934	885	4819
Recovery and Treatment	278	757	1035	335	757	1092
Human Health Studies	<u>2051</u>	<u>-</u>	<u>2051</u>	<u>3117</u>	<u>-</u>	<u>3117</u>
Totals	10,866	5114	15,980	15,037	5114	20,151

B. Funding for Supporting Research

Critical Organ Systems	2957	-	2957	3083	-	3083
Improved Assay Systems	1635	750	2385	2038	750	2788
Genetic Research	1303	-	1303	1463	-	1463
Molecular and Cellular Studies	<u>9919</u>	<u>-</u>	<u>9919</u>	<u>12445</u>	<u>-</u>	<u>12445</u>
Totals	15,814	750	16,564	18,507	750	19,257

* PRESENT FY 77 BUDGET WILL COME IN UNDER THIS
FIGURE

B. Detailed Description of Program Objectives

1. Technology Oriented Objectives

a. Screening for Hazardous Agents

A systematic sampling and biological screening program has been organized to identify the most potent carcinogens, mutagens, teratogens and physiologically detrimental agents which occur in process streams, and effluents from various fossil fuel extraction and conversion technologies. Associated chemical research includes sampling, characterization, preservation, preparation and standardization of samples to be used for bioassay. Rapid in vitro and in vivo screening systems are being used to assay crude and fractionated samples as well as purified compounds. The most toxic agents will be further tested in experimental animals to confirm the biological hazard and provide a first step towards predicting the risk to occupational and general segments of the human population. In view of the large number and variety of chemical agents of potential toxicity and the short time frame in which the information must be obtained, this program will reduce and prioritize those agents for further assessing their potential risk to human health.

Six ERDA laboratories (Holifield National Laboratory, Pacific Northwest Laboratory, Lawrence Livermore Laboratory, University of California, Los Angeles, Argonne National Laboratory, and Franklin McLean Memorial Research Institute) are participating in these studies to provide preliminary identification of mutagenic and carcinogenic activity of inorganic and organic components of fossil fuel processing and conversion facilities.

The screening methods include inhibition of bacteriophage replication, and production of frame-shift mutations in the bacterium Salmonella, each of which identifies carcinogens with 90 percent reliability. This reliability requires incorporation of a liver extract which contains both activation and detoxifying enzymes. Further testing and screening is performed in animals using in vitro treated transplantable mammalian cell and tissue systems or by in vitro assay for cell transformation of primary cell explants of several mammalian organs.

In three laboratories (Argonne National Laboratory, Holifield National Laboratory, and Lawrence Berkeley Laboratory) efforts are being made to differentiate between the inducing and promoting activities of hydrocarbons and other agents associated with the various fossil fuel technologies.

At Holifield National Laboratory, a multidisciplinary program is in place to perform rapid screening coupled with analytical chemistry preliminary to confirmatory animal testing for both mutagenic and carcinogenic activities in process streams and products of several facilities presently engaged in small scale production of synthetic liquid and gaseous fuels from coal.

b. Fate and Metabolism

A systematic evaluation of the fate and metabolism of the hazardous agents is being developed to supply the dose parameter for the animal testing program. Four major facets to characterizing the metabolism of potentially toxic agents are (1) enzymatic activation or detoxification especially for the hydrocarbons associated with fossil fuel technologies, (2) detailed assessment of the uptake, translocation, retention, and excretion of organic and inorganic chemicals, (3) precise

determination of the dose to the critical organ or tissue and its relationship to the magnitude of the effect, and (4) development of new theoretical concepts and methods to ensure the extrapolation to man especially for low level exposure.

Efforts have been initiated at the Inhalation Toxicology Research Institute, University of Tennessee-Comparative Animal Research Laboratory, University of California-Davis, Argonne National Laboratory, Pacific Northwest Laboratory, and Brookhaven National Laboratory, to obtain such information for trace elements, heavy metals, and some gaseous pollutants and polycyclic aromatic hydrocarbons which are associated with effluents and products of fossil fuel combustion and conversion facilities. Aerodynamic particle size distributions are being characterized for aerosols administered to rodents and dogs as single, repeated or chronic exposures. Methods for synthesizing isotopically labeled organometallic and organic atmospheric pollutants are being developed for measuring organ doses and localized tissue distributions. Gastrointestinal absorption and secretion of cadmium as a function of dose, diet and animal species are being studied in vivo and in vitro with particular interest in defining the impact of cadmium on the absorption of specific nutrients.

c. Pathophysiological Effects Including Respiratory Toxicology

The most likely human exposures to most of the potentially toxic agents in expanded use of fossil fuels will be through the respiratory pathways. The most likely toxic agents are oxidation products of sulfur, carbon and nitrogen, condensed hydrocarbons and particulates containing heavy and trace metals in dust and fly-ash. Although it is known that a combination of these agents produce disabling and fatal human diseases, neither the causative agent(s) nor the sequence of

pathological progression are understood. New experimental research in model experimental animals is needed to define the causative agents for initiation of diseases such as pneumoconiosis and to elucidate the exposure conditions that lead to eventual massive pulmonary fibrosis and emphysema.

Techniques and methods for such studies have been a major part of the nuclear program at Pacific Northwest Laboratory, the Inhalation Toxicology Research Institute, Holifield National Laboratory, and the University of Rochester. These efforts have been reprogrammed or expanded to include efforts devoted exclusively to respiratory problems associated with fossil fuel technologies. Data will be obtained on acute, subacute and latent physiological impairment of function of respiratory, cardiovascular and other systems resulting from inhalation of gaseous pollutants from pilot plant operations of fossil fuel conversion systems. Evaluation of interactions between inorganic and organic pollutants encountered in both the occupational groups and the general population by way of effluents from these processes will be made. Dose-effect relationships will be the ultimate output from these studies.

A collaborative respiratory toxicology program between Brookhaven National Laboratory and the State University of New York, Stony Brook, will be initiated in FY 1976 by reprogramming funds at Brookhaven National Laboratory. The program is multidisciplinary in nature and involves complementary expertise in both institutions. The goal is to intercompare animal and human information for damage to the respiratory system by irritant gaseous effluents and other products of fossil fuel technologies. The program will stress the early and latent disease states that lead to pulmonary incapacitation and cancer. Optimal use

will be made of the most advanced physiological and clinical diagnostic methods and instruments for early detection of disease states in humans.

d. Carcinogenesis

The carcinogenic properties of products, particularly the polycyclic and other aromatic hydrocarbons as well as trace elements and radionuclides, of coal conversion and shale distillation are being characterized using simple animal cell systems and intact organisms. Efforts focus on their effects on (a) virus activation and on the mechanisms controlling oncogenic expression as a result of both acute and more chronic exposure, (b) direct malignant transformation both in cultured cells and in animals, and (c) the host's immunologic ability to resist virus-induced cancer or to control pre-existent neoplasm via immunologic attack. Synergistic studies with sub-effective doses and dose-rates of ionizing radiation and other potentiating agents including suspended particulate matter, SO_x , As, etc. will also be performed to increase the sensitivity of the analyses while providing data on synergism. Long-term animal studies in various species will be initiated only after specific chemical and physical agents and conditions of exposure are more fully defined. Additional emphasis is being placed on developing theoretical models to facilitate extrapolation of data obtained with medium and high level exposures in animals to low dose exposure levels more likely in human populations.

About one million dollars of research effort was initiated as new work or reprogrammed work in FY 1975 to establish a base of animal testing for carcinogenic risk of organic or inorganic chemicals known to be present in process streams or products of fossil fuel facilities presently involved in production of synthetic fuels. The major efforts

are conducted in ERDA laboratories previously involved in nuclear technology.

At Argonne National Laboratory, the major efforts address coal combustion problems. Two studies involve attempts to delineate initiator versus promoter activities of polycyclic hydrocarbons for skin and lung tumors using established model tissue and cell systems.

At Argonne and Holifield National Laboratories as well as at Lawrence Berkeley Laboratory and in university-based laboratories, theoretical and experimental modelling studies are being conducted to improve and perfect our ability to extrapolate experimental animal data to man in terms of chemical dose to specific organs with major emphasis on low exposure doses. The use of transplantable organs and tissues at Holifield National Laboratory is employed to evaluate damage and to follow temporal progress of cell and tissue damage leading to the malignant state. These programs have been initiated with reprogramming and inter-agency energy funds, and will be expanded in FY 1977.

e. Mutagenesis and Developmental Effects

Studies have been initiated at Lawrence Livermore Laboratory, University of California, Los Angeles and Pacific Northwest Laboratories to evaluate the dose effect relationship for both loss of reproductive function and production of non-reproducing or defective offspring resulting from fetal exposure to trace and heavy metals as well as toxic hydrocarbons. The influence on mammalian development and chromosomal defects will be analyzed in experimental animal populations as a function of dose. Fast flow cytological analyses can also be applied to human occupational groups for early detection of potentially hazardous exposure.

The development of experimental systems to determine the mutagenicity of chemical compounds and agents has been at the forefront in ERDA's mutagenesis program. A variety of noxious chemicals are already identified as potent mutagens. Polycyclic hydrocarbons are known to produce a very specialized effect that disrupts the DNA-coding function. One important project at the University of California, Berkeley, employs bacterial systems to screen environmental mutagens. Mutations are detected with great sensitivity and, by using enzyme complexes from human or other mammalian liver in the system, the metabolic and physiological conditions of the mammalian body are simulated. This system has now been widely adopted by laboratories concerned with an initial screening of potential environmental mutagens. At HNL a mutation-testing laboratory has been established to test the mutagenesis of compounds emanating from the coal and oil technologies. This is the principal laboratory which is capable of testing compounds in a wide variety of biological systems. The systems include tests in bacteria, yeast, insect and mammalian organisms. This laboratory is the prototype of an advanced unified test-laboratory and has the responsibility for producing and combining the most informative and efficient battery of tests for the protection of man.

At BNL there is further work to develop and utilize a sensitive mutation-test system in the plant *Tradescantia* to detect environmental mutagens. A powerful technique has been developed at LLL for the study of cellular and chromosomal abnormalities induced by mutagens. Stained chromosome pass through a laser beam at high speeds where the DNA content is measured precisely and recorded electronically. This method now provides an elegant way to identify and characterize abnormal

chromosomes and can sort out types of chromosomes for further biological or chemical analysis. Further work is needed to develop mutation-test systems in mammalian systems and significant expansion is projected for this purpose.

f. Molecular and Cellular Mechanisms

Biological problems associated with exposure to pollutants from coal combustion and conversion processes strongly rely on cellular and molecular level research to provide a conceptual basis for analyzing the effects of pollutants. The pollutant classes of major interest currently center around the sulfur and nitrogen oxides, the polycyclic hydrocarbons and heavy and trace metals.

The entry of a pollutant into a cell requires that it first pass through the cell membrane; consequently, studies have been initiated on the effect of pollutants on the structure and function of natural cell membranes and model systems. Alterations in the normal distribution of lipoproteins and the enzymes of lipid metabolism will be studied in the membranes of lung tissue of animals exposed to atmospheric pollutants (ORAU). Human lung cells in culture exposed to pollutants will be examined for changes in the physical structure of the cell membrane and for the integrity of transport functions (LBL). The polyunsaturated fatty acids of tissues are known to be particularly susceptible to oxidation by gaseous pollutants so studies of polyunsaturated fatty acids will be expanded to include NO_2 -initiated autoxidation of membrane lipids (UCLA), and protection of membrane lipids against oxidation by vitamin E. The surfactant lipids of the alveolar fluid will be examined for their susceptibility to alteration by pollutants (UCLA).

Serum lipoproteins, which act as transport vehicles for many substances in the blood, will be studied as possible carriers of polycyclic hydrocarbons and trace metals from the site of entry in animals to their final deposition in specific tissues. The action of ozone and nitrogen oxides will be studied on the integrity of serum lipoproteins and on the enzymes of lipoprotein metabolism.

There is much evidence to suggest that the chemical reaction of certain important organic pollutants with cells, in particular the polycyclic aromatic hydrocarbons, proceeds through a free radical mechanism and that reactive radical species can be produced by the action of cellular enzymes during metabolic detoxification. Studies are being initiated to produce free radicals from known hydrocarbon carcinogens and observe their interaction with nucleic acids (BNL). A broad program on the chemistry and metabolic reactions of polycyclic hydrocarbons will be initiated to study their activation by cellular enzymes and the role of those activating enzymes in cell transformation brought about by polycyclic hydrocarbons (LBL).

Organic compounds may act as transducers of light energy and cause the inactivation of biological molecules and the destruction of cells, consequently, studies in progress on photodynamic action will be expanded to include the action of nonnuclear pollutants (HNL).

Some plants are extremely sensitive to atmospheric pollutants such as SO_2 and NO_x , showing depressed growth rates even in the absence of pathological symptoms. The cellular biochemistry of SO_2 metabolism in sensitive and resistant plants is being investigated (PRL/MSU) in order to isolate and identify the sensitive biochemical systems.

Physical studies including x-ray diffraction will be made of the interaction of polycyclic hydrocarbons with nucleic acids, and new and highly sensitive techniques to measure the integrity of DNA will be used to study the effects of chemical agents on strand breakage in DNA and chromatin and the interaction of DNA with platinum (HNL).

The interaction of pollutants with DNA and RNA may not only inhibit their synthesis but also cause distortions in their ability to transfer genetic information correctly. The introduction of errors in DNA during replication and in RNA during synthesis (LASL) will be studied in model systems. Studies will also be made of how chemical mutagens bind to DNA and how inhibitors of this binding can prevent frameshift mutations.

Studies of the interaction and effect of pollutants on cells using single cell analysis and sorting systems will include the binding of chemical carcinogens to lymphocytes and their transformation by interference with RNA and protein synthesis during the cell cycle (LASL). A study of the synthesis of tissue specific proteins by cells in culture will be expanded to determine if polycyclic hydrocarbons can alter the protein synthesis pattern of normal liver cells to resemble that of tumor cells (HNL). Studies will also be conducted on how methylation processes in cells are used for the enzymatic methylation of heavy metals. Preliminary findings show that biological rhythms may be altered by various chemicals so a study will be initiated to look at the effect of pollutants on biological rhythms.

In addition to studies to define the mechanism and chemical nature of damage to cell macromolecules and organelles by fossil fuel pollutants studies of the repair of such damage are being actively pursued. These

include studies (1) to define the optimal dietary ratio of antioxidant to polyunsaturated fatty acid to prevent or minimize cellular membrane damage by oxidative pollutants (UCLA), (2) to devise compounds which interfere with the toxicity of benz(a)pyrene (LBL), and (3) to determine the effectiveness of radiation repair systems for DNA to deal with chemically induced lesions (HNL).

g. Recovery and Treatment

Several studies have recently been initiated to develop safe and effective techniques for chemical binding (chelation) and removal of incorporated heavy metals. At the Argonne National Laboratory, EDTA (ethylenediaminetetraacetic acid) and DTPA (diethylenetriaminepentaacetic acid) have been successfully encapsulated within lipid spherules, i.e., liposomes. These preparations will be tested for heavy-metal chelation in the spleen and bone marrow (using liposomes with negative surface charges) and in the lungs and brains (positively charged liposomes). In related work at ANL, carbon-14-labeled DTPA will be used to determine the localization of this chelate in order to improve its efficiency in heavy-metal decorporation. Studies are under way at the Pacific Northwest Laboratory to produce and test biologically derived chelators for removal of incorporated toxic metals (cadmium, vanadium, nickel and cobalt), to examine drugs that might make the internally deposited metal more readily available for removal, and to develop methods of stimulating natural detoxication and elimination mechanisms. At the University of Rochester, research will continue on the removal of internally deposited mercury by introducing insoluble sulfhydryl chelating agents into the gastrointestinal tract.

A smaller effort will be devoted to other classes of chemical agents. Of particular interest is research to be conducted at PNL in which attempts will be made to detoxify chemical agents (including polycyclic carcinogens) in vivo and to retard biological conversions of chemicals to toxic or more toxic forms within the exposed individuals.

An evaluation will be made of the sensitivity of those mammalian tissues whose function is normally maintained by high cell turnover and replacement efficiency. Among these are the intestinal and lung epithelium, the hematopoietic and immune systems. Interference with the cell replacement mechanisms will be assessed as a function of exposure dose of inorganic and organic agents associated with fossil fuel conversion processes and effluents released from pilot plant operations.

Studies are underway to evaluate the nature of the reparative and adaptive mechanisms which take place in the respiratory system in response to damage by sulfur compounds and/or particulates such as SiO_2 and fly ash in rodents and nonhuman primates (U.C.-Davis, ITRI) the role of alveolar macrophage and alveolar epithelium and other pulmonary cells in influencing the spacial-temporal distribution and alveolar clearance of inhaled metal oxides (PNL), the impact of energy-related particulates and noxious gases on the physiology and pathophysiology of phagocytic cells in vitro (FEMRI), the effects of exposure to and recovery from coal gasification byproducts on mammalian peripheral blood cell composition and blood forming tissues by application of recently developed rapid analytical, all analyses and sorting flow-system instrumentation (IASL), recovery in mice from the effects of a carcinogenic polycyclic hydrocarbon on the size and the proliferative and

functional capacity of different sub-sets of immunocompetent cell (ANL), perform a critical analysis of the immune response functions in an animal primate model exposed to agents known to affect neoplastic alterations in a specific target tissue, the gastric mucosa (ORAU), define the importance of immunocompetence in recovery from various pathophysiological insults including carcinogenesis following respiratory tract and gastrointestinal exposure to aromatic hydrocarbons, nitrosamines, with and without potentially synergistic agents in normal and immunologically deprived rodents (IASL), determine the extent to which T & B lymphocytes exposed in vitro or in vivo (rodents) to coal gasification byproducts retain or reserve their potential for immunostimulation by various nitrogens (IASL).

h. Human Health Studies

At each stage of development and expansion of the emerging energy technology it is likely that occupational groups and some members of the general population will be exposed to a large number and variety of organic and inorganic chemical agents of potential health hazard.

An epidemiologic study of the incidence of disease in coal miners with emphasis on non-pulmonary disease categories is planned for initiation in FY 76. The study will bring additional evidence to bear on a reported increased incidence of such disease among miners. A study of workers in TVA coal-fired plants will also be initiated to define the incidence of disease in the population of workers in the plants and of respiratory impairment as measured by pulmonary function testing in a representative sample of workers. The spectrum of plants in the TVA network would permit a comparison of health experience between workers in positive and negative pressure coal-fired plants. This comparison is relevant because the concentration of effluents in the internal plant atmosphere may vary substantially between these two types of plants.

The collection of health data will be initiated for workers in coal conversion pilot facilities in EEDA Energy Research Centers. This effort will be preparatory to mounting epidemiologic studies of the incidence of disease that might be caused by the various chemicals encountered as effluents and residuals of the processes under development. Increased numbers of workers in the study populations will become available when the demonstration and commercial plant stage is reached for processes of interest.

Epidemiologic studies of health and related statistics for populations near fossil and nuclear energy facilities are under way at ANL and HNL. These are pilot studies to develop a methodology for describing the populations surrounding such plants in terms of demographic and socioeconomic statistics as well as indices of health. The study at HNL is concerned with the State of Tennessee and the Oak Ridge area in particular. At ANL the study will include eleven widely distributed plants that are representative of disparate plant operations and both population and geographic conditions.

The analytical group at LASL presently conducting a major program analyzing the concentrations of radionuclides in human tissues of the general and worker populations will analyze the tissues for lead, mercury, beryllium, and other metals associated with fossil fuel combustion. Since the sources of tissues include urban, rural and highly industrialized areas, the study will investigate the relationship of a broad spectrum of air pollution conditions to metal concentrations in tissues.

An investigation will be initiated on the potential impact of interruption of adequate energy supplies on public health services and health care delivery. The study by investigators at Loyola University in New Orleans will utilize local public health and hospital statistics to estimate the impact of diminished energy availability on services provided in the metropolitan New Orleans area. In addition, assessment of the information available concerning nationwide

aspects of this potential problem will be provided. Eventual generalization of this research activity to include an estimation of the potential impact on health services for the entire nation, including rural areas, is contemplated.

Genetic research in humans is almost entirely directed toward assessing the risk of mutagenesis to man from environmental agents or potential chemical mutagens. One program at Stanford University is directed toward understanding the mutation loads in man which is a necessary prerequisite to assessment of increased risks and loads due to energy-related chemicals. In Iceland there is an important study of a related kind where complete registrations of vital records of the entire population for several generations have been linked together with epidemiological data to permit assessment of the genetic and environmental bases of human ailments and disease. Such data are essential to an understanding of the extent to which human illness and disease is founded on natural genetic variation and mutations in order to make assessments of the additional health consequences from increased mutational loads. The major program to assess natural rates of mutations in man is conducted at the University of Michigan and is a new attempt to use biochemical techniques for detecting mutations routinely in both fetal cord blood and parental blood sample. This is the only research program in existence to monitor and assess transmitted mutations directly in man, and the level of effort will be markedly accelerated.

2. Supporting Research

The supportive research is conducted primarily in university based laboratories but also in the following ERDA laboratories: Holifield National Laboratory, Brookhaven National Laboratory, Argonne National Laboratory, Pacific Northwest Laboratories, Inhalation Toxicology Research Institute, Lawrence Livermore Laboratory, Los Alamos Scientific Laboratory, Michigan State University Plant Research Laboratory, and the University of California, Los Angeles.

a. Critical Organ Systems

The hematopoietic system is easily perturbed by physical and chemical agents and leads to disturbances of production of both white and red blood cells. These disturbances lead to a variety of diseases including septicemia, anemia and leukemia. Studies at Lawrence Berkeley Laboratory, Brookhaven National Laboratory, and Holifield National Laboratory as well as at a number of university laboratories involve an assessment of normal function of this system.

The immune system comprises a first line of defense of the body against infectious and malignant diseases and is sensitive to a number of chemical and physical agents. Studies at Franklin McLean Memorial Research Institute and a number of universities attempt to understand how the immune system functions and is perturbed.

Both the reproductive system and the developing embryo are uniquely sensitive to a variety of agents that can induce sterility or a variety of disease states in the offspring. At Lawrence Livermore Laboratory and two universities, studies of normal development are conducted.

Several other organs and tissues are prime targets for damage from chemical agents because the materials either are concentrated in them or are retained there for a long time. For example, the lung is a primary target for most aerosolized agents while the skeleton is a site of deposition and retention of many trace and heavy metals. Research in ERDA and university laboratories attempts to understand the basic physiology of these organs or tissues.

b. Development of Improved Bioassay Screening Systems and Early Indicators of Damage

An impressive battery of cytological, biochemical and physiological indicators of cellular, tissue and organ damage are under development in the ERDA laboratories. Several of these systems will ultimately provide improved means of detecting and monitoring for damage to the human population from exposure to a variety of physical and chemical agents. At the same time, such tests can provide a realistic method for extrapolating results obtained in experimental animals to normal and susceptible segments of the human population. Promising methods are incorporated into both animal and human research efforts as expeditiously as possible.

Since plants and plant tissue cultures can also be induced to form tumors with chemical agents, research has been initiated at Michigan State University to develop a sensitive carcinogen/mutagen bioassay based on these properties. This project also includes examining embryo formation in plant tissue cultures as a potential means of assessing the teratogenic properties of pollutant chemicals.

Expertise in nuclear medicine research is being exploited to develop the use of new radionuclides and radiopharmaceuticals for the early diagnosis of human diseases. This objective is pursued by supporting research at major onsite laboratories and several university medical laboratories. In addition, the "onsite" laboratories conduct cooperative programs both with their colleagues in the basic sciences and in clinical medical practice.

The nuclear medicine research program develops radionuclide procedures which provide unique diagnostic information or which are necessary to essential information in support of other diagnostic procedures. Enhanced organ imaging techniques occupy a major interest in the program. Due to recent advances in instrumentation, there is a growing emphasis on assessment of organ function in general and pulmonary and cardiovascular functions in particular.

A comparative study at Franklin McLean Memorial Research Institute (FMMRI) demonstrated the superiority of N-13 ammonia over TC-99m labeled phosphates to define myocardial infarcts. Research on labeling metabolic compounds with the cyclotron-produced short-lived isotopes is being actively pursued. Use of such compounds will provide data heretofore difficult if not impossible to acquire.

A cooperative study initiated by the Hollifield National Laboratory with six medical institutions using a common clinical protocol to evaluate potassium-43 in detection of coronary artery disease has just been completed. Over 250 patients were studied. Although the final analysis of the data has not yet been completed, the following preliminary conclusions may be drawn.

Changes in the K-43 images were observed in patients where conventional tests failed to detect abnormalities. Also, use of K-43 appeared useful in identifying certain categories of high risk patients that should be excluded from surgical intervention (e.g., by-pass operation). In general potassium-43 may be a more sensitive than other techniques for detection of single artery disease prior to onset of myocardial damage.

Development of new methods for measuring lung function are being continued at Brookhaven National Laboratory. An important advance in this area was made by the development of a new class of agents. These agents localize in the lung and subsequently are metabolized by lung tissue. Administration of these agents not only allow imaging of the lung but at the same time provide valuable information on the metabolic integrity of the tissue itself by measuring the rate of release of radioactive labeled carbon dioxide in the expired air. Combined with more conventional ventilation and perfusion studies, use of these agents will open up new avenues to study lung disease.

Comparative assessment of a lung function in a small randomly selected population utilizing dry aerosol techniques, radioactive xenon, and conventional techniques are being conducted at the University of California, Los Angeles. In addition, preclinical studies in heart physiology are being expanded in order to expedite the clinical application of a tomographic scanner for positron emitters. In addition, an active program in developing new chemical labeling techniques using short-lived isotopes of various biologically active compounds is being carried out. One of the products of this program (alcohol labeled with radioactive fluorine) is being assessed as an agent to measure regional brain perfusion.

(c) Genetic research

Mutagenic agents interact with DNA in a variety of ways that depend upon numerous chemical and physical properties of mutagens. These properties are fundamentally related to the types of mutations that arise, the mechanisms of their formation and mutation frequency. A broad base of support is necessary in order to detect mutagens, to identify the nature of resulting mutations and to identify classes of mutagens according to the kinds of mutation they produce.

Characterization of the mutagenic process is underway in a variety of simple to complex experimental systems. At BNL, chemical mutagens are administered to synchronized populations of cultured mammalian cells, and the types of chromosomal aberrations are observed. The associations between type of mutagen, stage of the cell-cycle and the type of chromosomal aberration are studied to develop an understanding of chromatin breakage and restitution. A better understanding will provide a greater capability for predicting the mutagenicity of an untested chemical compound.

In well-defined experimental systems such as yeast, it is possible to analyze mutations in terms of changes in molecular structure of genes. At the University of Rochester, elegant documentation is ongoing in which the mechanism of mutagen action can be related to a particular kind of molecular change. Other work at HNL and a number of university laboratories is contributing rapidly to information about the kinds of mutations certain mutagens produce. The permanent fixation of a mutational change within the informational content of the chromosome is far from an instantaneous event. Mutagenesis is intimately related to DNA replication and to DNA transcription. High quality studies of transcription mechanisms and DNA replication are being carried out at APL, HNL, BNL as well as at Duke and Stanford Universities.

One of the most exciting advances in genetics is the development of new methods that permit genetic analyses of mammalian somatic cells grown in tissue culture. Similar techniques allow genetic advances in plant cells grown in a cultured medium. About \$1,000,000 of somatic cell genetics research is currently being conducted at HNL, LLL, LASL, Michigan State University and at the Institute for Cancer Research. Although new initiatives have been undertaken in order to approach the assessment of possible synergistic interactions between different mutagenic agents, these programs will require appreciable expansion. Several studies of synergisms with mammalian systems are underway at HNL, while similar experiments with plant systems are being conducted at BNL and Michigan State University. The relatively new area of somatic cell genetics (in both plants and animals) should receive a steadily increasing base of support owing to the vast potential for fundamental understanding of higher plant and animal cells. It will be possible to gain insight into gene-enzyme relationships that were previously possible only with simple organisms, such as bacteria.

To provide information on the spread of mutations through organismal populations, there are studies at the University of California, Harvard University, Cornell University, and the University of Washington on the genetical structure of natural animal populations. Some of this work is experimental, and other work is theoretical in nature employing computer simulation techniques. In each case, the objective is to examine the importance of the various natural parameters which influence gene frequency and fitness of populations. The possible synergistic effects of particular combinations of these forces are also studied. A good genetical theory of the forces

At the molecular level, it is becoming increasingly possible to organize classes of mutagens according to DNA damage patterns; and it is clear that different repair mechanisms exist to cope with different types of repair damage, although these mechanisms often overlap. Some chemicals produce very specific effects, while others trigger multiple effects. The enzymes that are involved in DNA repair cause reactions which are also involved in such processes as DNA replication or DNA recombination. In fact, there is evidence that some of these enzymes may have multiple, overlapping functions. Therefore, alterations in repair enzymes as the result of mutations may simultaneously alter other cellular functions. Considerable emphasis is being given to the sorting out of a large number of complex gene-enzyme relationships, taking into account the heterogeneous array of different repair systems as well as the possible multi-functional roles of repair systems in other DNA processes. As the enzymological basis for various repair systems becomes better established, knowledge of the control mechanisms which govern the regulation of repair systems will become of increasing significance.

Increased emphasis should be placed upon enzymological studies in order to articulate the complex and overlapping molecular relationships between the mutation process and the interrelated processes of DNA replication, genetic recombination and repair of DNA damage.

d. Molecular and Cellular Studies

The objective of work at the molecular level is to understand the physicochemical and biochemical basis of the interaction of pollutants with biological materials to determine how this interaction results in genetic and physiological effects. Studies in this category will identify the physical and chemical interactions of primary

and secondary pollutants with biomolecules, cell structures, and cell organelles, and will relate alterations in the structure of these entities to deleterious changes in cellular processes and functions.

Much of the work in this category provides information on the basic properties of biomolecules and cells which when coupled with information from applied studies allows a detailed picture of the action of a pollutant to be drawn. Basic studies can also provide leads for new approaches to programmatic problems.

Work in Biophysics supportive of programmatic needs includes the basic mechanisms of energy absorption by molecules, the transfer of energy within and between molecules, the reactivity of excited molecules, and the characterization of the final chemical states of the molecules. Energy absorption and transfer studies include the fundamental spectroscopy of singlet molecular oxygen, the effect of electronic excitation on hydrogen bonding, photoinitiated processes in vision, and the mechanism of light generation in chemiluminescence and bioluminescence. Studies of the chemical changes following the absorption of energy provide information on the reactive sites of macromolecules and subcellular structures and the types of biochemical lesions to be found.

Also included under Biophysics are studies by physical methods of the structure and properties of selected macromolecules and cellular structures. Current studies include the structure of oligonucleotides and polypeptides in solution, the three dimensional structure of proteins, and the structure of the complex assemblies of macromolecules that exist in biological membranes.

The central role of nucleic acids, particularly DNA, as repositories of cellular information makes damage to them of especial importance; consequently, much supportive effort is directed towards understanding how the nucleic acids form an information storage and transfer system and how that information is expressed. The products of the information system are proteins and the growing list of diseases that have as their basis the absence of or some abnormality in a protein points out the importance of understanding how information is stored, expressed, and protected. Basic studies being conducted include the structure and molecular arrangement of DNA and protein in chromosomes; coordination of the activity of RNA found in organelles with nuclear RNA; the enzymes involved in the replication of DNA; and the isolation of enzymes useful for analyzing the base sequence of DNA. RNA is also an informational macromolecule, and the structure and role of the various forms of RNA, e.g. transfer, messenger, and ribosomal are being actively studied.

Specific projects include: the mechanisms by which amino acids are selected and assembled by RNA into the unique sequence of a specific protein; the chemical modification of the bases in RNA, and their relationship to the final folded structure of RNA and the sequence of t-RNA in normal and tumor cells.

The temporal sequence of nucleic acid synthesis and the expression of genetic information during the cell cycle is being determined as part of a program on the growth, division, and differentiation of mammalian cells in culture. These studies include normal cells from animals and humans, tumor cells, and cells infected with viruses. Research

activities include the cyclical changes in the activities of protein kinases; the regulation of protein synthesis in tumor cells; the hormonal regulation of protein synthesis in brain cells; and growth and division in cultured mammalian heart cells during maturation. Other studies include the comparative biochemistry of normal and transformed or tumor cells. Studies of the cell cycle in plant meristems are conducted to determine how environmental stresses and chemical mutagens affect cell division.

Many studies in cell growth and differentiation now include an examination of the role of the cell membrane because of the growing recognition that cell membranes are active participants in cell metabolism. Specific studies of the cell membrane include: determination of the composition of membrane proteins and lipids, the structure of membranes by electron microscopy and neutron diffraction, the synthesis of membrane lipids in normal and tumor cells, the role of the cell membrane in the regulation of cell division, the transport of ions and organic nutrients in normal and transformed cells.

Enzymes are studied in many parts of the program as biological processes are almost invariably conducted through the use of enzymes, and the regulation of cellular activity usually means the regulation of some enzyme activity. Fundamental studies are conducted to provide information on the general structural and chemical properties of enzymes and on the basic nature of catalysis.

Pollutants may not cause simple changes in overall metabolism, but may produce subtle effects like altering biological rhythms. To this end studies in progress are seeking to establish the molecular mechanism of circadian rhythms in free living animal cells and in higher plants. Also in plants,

the hormonal regulation of cellular activities are being investigated with respect to membrane function, growth and RNA metabolism since hormonal-pollutant interaction appears to be of critical importance.

PART IV. Projections - Summary and Recommendations

A. Projections for Future Research

B. Summary and Recommendations

A. PROJECTIONS FOR FUTURE RESEARCH

The research program described can now begin to supply the immediate needs of the coal based technologies by addressing the highest priority health problems. The research strategy demands that heavy emphasis be placed immediately on chemical and biological identification of the most hazardous agents present in gaseous and liquid effluents, process streams and synthetic product-by-products of modified or energy technologies. The program provides for a few large scale animal studies to define with reasonable accuracy the dose-effect relationship for mutagenicity, carcinogenicity, embryotoxicity and production of important pathophysiological effects on organs and organ systems. Moreover, the present program provides for a small but significant effort aimed at defining the step-wise progression of disease states in sensitive organs. These efforts will have to be expanded in the FY-1977 and following years if the information required for decision-making is to be available in the projected time frame for large scale development in each technology.

Initiation or expansion of programs will require discussions with other health-oriented agencies. In addition, these programs will be developed on the basis of continuing balanced program in concert with the needs of the several ERDA technology and research divisions.

It is clear that programs of medical surveillance and industrial hygiene and safety will be required for occupational groups involved in ERDA developmental facilities primarily at ERDA Energy Centers throughout the nation. These will be established as working models for industrial operations when the technologies are commercialized.

A continuing effort will be made to bring to early application a battery of biological methods that can be used as early indicators of damage to occupational groups in order to monitor the health and safety of the technological development. A number of such programs are in an embryonic stage but are expected to progress rapidly. These programs are under way in other agencies as well, and the mechanisms for rapid exchange of information are already established by way of frequent Interagency Meetings. Only 2 year projections are shown here. Five year projections are being prepared and will be presented later.

While the present program relies heavily on the expertise in the ERDA Laboratories, a large number of University-based research projects are also included. Current distribution of funds is shown in Table III. The National Laboratories as well as the Energy Centers are in regions of major technological activities. Since these developments are also close to major Universities, clinical research centers, Schools of Public Health, etc., it is important to expand research efforts into educational institutions nearby to stimulate manpower training for ERDA needs as well as to conduct environmental and health research in the specific regions where the major developments will occur. This plan is being studied in detail.

Table III Distribution of Research Funds

A. Funding for Technology-Oriented Objectives

		<u>FY 76 Budget (K)</u>	
		<u>Labs</u>	<u>Univ/Hosp</u>
Screening	Base	914	33
	Pass-thru	<u>920</u>	<u>80</u>
		1834	113
Fate & Metabolism	Base	155	380
	Pass-thru	<u>296</u>	<u>90</u>
		451	470
Respiratory Toxicology	Base	394	529
	Pass-thru	<u>500</u>	<u>100</u>
		894	629
Pathophysiology	Base	1150	531
	Pass-thru	<u>100</u>	<u>-</u>
		1250	531
Carcinogenesis	Base	490	75
	Pass-thru	<u>370</u>	<u>330</u>
		860	405
Developmental & Muta- genic Effects	Base	688	130
	Pass-thru	<u>586</u>	<u>100</u>
		1274	230
Molecular & Cellular Processes	Base	2399	669
	Pass-thru	<u>740</u>	<u>145</u>
		3139	814
Human Health	Base	1019	1032
	Pass-thru	<u>-</u>	<u>-</u>
		1019	1032
Recovery & Treatment	Base	278	-
	Pass-Thru	<u>557</u>	<u>200</u>
		835	200

Total % National Laboratories = \$11,556 72.3%

% Universities = 4,424 27.7%

B. Funding for Supporting Research

		<u>FY 76 Budget (\$)</u>	
		<u>Labs</u>	<u>Univ/Hosp/priv. inst.</u>
Critical Organ Systems	Base	1608	1349
	Pass-thru	-	-
		<u>1608</u>	<u>1349</u>
Improved Assay Systems	Base	861	774
	Pass-thru	<u>650</u>	<u>100</u>
		1511	874
Genetic Effects	Base	787	516
	Pass-thru	-	-
		<u>787</u>	<u>516</u>
Molecular & Cellular Studies	Base	7665	2254
	Pass-thru	-	-
		<u>7665</u>	<u>2254</u>

Total % National Laboratories = \$11,571 69.9%

% Universities = 4,993 30.1%



B. SUMMARY AND RECOMMENDATIONS

(1) As a result of judicious reprogramming the use of interagency energy program pass-through funding and initiation of new efforts with FY-1976 ERDA funds a major health effects program is in place in ERDA national laboratories and university-based laboratories. The program emphasizes solution of potential health problems associated with coal extraction, processing and combustion as well as the conversion of coal to synthetic liquid and gaseous fuels.

(2) The present ERDA health effects program is based on a series of planning exercises initiated in 1973 which included interaction and consensus representatives of the technologies, scientific investigators, technical representatives and key administrators of health-oriented government agencies.

(3) Interagency consensus and priorities were established by objective evaluation of (a) information needs, (b) magnitude and severity of potential health problems, (c) urgency for obtaining information based on projected time line for various energy technological development.

(4) The program initiated represents a minimal effort and corresponds to the temporal sequence of the research strategy required to meet ERDA needs.

(5) The minimal program must be fortified as it moves into the more expensive animal studies required to establish accurate dose-effect relationships for mutagenesis, carcinogenesis, pathophysiological and embryotoxic effects. While some redirection of effort can be accomplished continually, the proper balance among all ERDA technologies must be maintained.

(6) Early emphasis on fossil fuel technologies, primarily those utilizing coal, is justified because (a) some health problems are common to several technologies and (b) near term energy technologies will utilize coal.

(7) As the occupational force involved in coal technologies increases, ERDA should implement model programs for medical surveillance, industrial hygiene and safety to be carried over into commercial facilities thereafter.